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Acknowledgments

This 2017 edition of the task list for Diesel Equipment Technology was validated by a panel of industry representatives and educators:

John M. Bishop, Diesel Technology Instructor, Tidewater Community College
Alan Crouch, Assistant Dean, School of Business, J. Sargeant Reynolds Community College
Jeffrey Hodges, Teacher, Buchanan County Technical and Career Center
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J. Harlan Wrenn, Training and Sales, Electude USA

The framework was edited and produced by the CTE Resource Center:
Course Description

Suggested Grade Level: 12
Prerequisite: 8614

Students receive advanced instruction in the repair of medium- and heavy-duty diesel trucks and equipment. They repair diesel engines, drive trains, brakes, suspension and steering systems, electrical/electronic systems, HVAC systems, and hydraulics systems. Students are also instructed in preventive maintenance and inspection procedures.

Legislation enacted in the 2011 Virginia General Assembly (HB 1493) and amended in 2012 (HB 1108) requires where there is a national industry certification for career and technical education instructional personnel or programs for automotive technology, the Board of Education must make such certification mandatory. The provisions of this act shall become effective July 1, 2013. To comply with the requirements, all Career and Technical Education (CTE) automotive programs must be NATEF accredited and the instructors must be certified by the National Institute for Automotive Service Excellence (ASE).

As noted in Superintendent's Memo #058-17 (2-28-2017), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.

Task Essentials List

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (◯) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.
<table>
<thead>
<tr>
<th>Task Number</th>
<th>8615</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REQUIRED SUPPLEMENTAL TASKS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practicing Lab/Shop and Personal Safety</td>
<td></td>
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</tr>
<tr>
<td>39</td>
<td>✗</td>
<td>Identify general lab/shop safety rules and procedures.</td>
</tr>
<tr>
<td>40</td>
<td>✗</td>
<td>Utilize safe procedures for handling of tools and equipment.</td>
</tr>
<tr>
<td>41</td>
<td>✗</td>
<td>Identify and use proper placement of floor jacks and jack stands.</td>
</tr>
<tr>
<td>42</td>
<td>✗</td>
<td>Identify and use proper procedures for safe lift operation.</td>
</tr>
<tr>
<td>43</td>
<td>✗</td>
<td>Utilize proper ventilation procedures for working within the lab/shop area.</td>
</tr>
<tr>
<td>44</td>
<td>✗</td>
<td>Identify marked safety areas.</td>
</tr>
<tr>
<td>45</td>
<td>✗</td>
<td>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.</td>
</tr>
<tr>
<td>46</td>
<td>✗</td>
<td>Identify the location and use of eye wash stations.</td>
</tr>
<tr>
<td>47</td>
<td>✗</td>
<td>Identify the location of the posted evacuation routes.</td>
</tr>
<tr>
<td>48</td>
<td>✗</td>
<td>Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.</td>
</tr>
<tr>
<td>49</td>
<td>✗</td>
<td>Identify and wear appropriate clothing for lab/shop activities.</td>
</tr>
<tr>
<td>50</td>
<td>✗</td>
<td>Secure hair and jewelry for lab/shop activities.</td>
</tr>
<tr>
<td>51</td>
<td>✗</td>
<td>Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits.</td>
</tr>
<tr>
<td>52</td>
<td>✗</td>
<td>Demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge [HID] lamps, ignition systems, injection systems, etc.).</td>
</tr>
<tr>
<td>53</td>
<td>✗</td>
<td>Demonstrate knowledge of safety data sheets' (SDS) location and content.</td>
</tr>
<tr>
<td><strong>DIESEL ENGINES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel Engines: Servicing Air Induction and Exhaust Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>✗</td>
<td>Inspect exhaust after treatment devices.</td>
</tr>
<tr>
<td>Diesel Engines: Servicing Fuel Supply System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>✗</td>
<td>Inspect fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, engine control module (ECM) cooling plates, and mounting hardware.</td>
</tr>
<tr>
<td>56</td>
<td>✗</td>
<td>Inspect pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings.</td>
</tr>
<tr>
<td>57</td>
<td>✗</td>
<td>Check fuel system for air.</td>
</tr>
<tr>
<td>Diesel Engines: Servicing Electronic Fuel Management System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>✗</td>
<td>Inspect power and ground circuits and connections.</td>
</tr>
<tr>
<td>Task Number</td>
<td>8615</td>
<td>Tasks/Competencies</td>
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<tr>
<td>-------------</td>
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</tr>
<tr>
<td>59</td>
<td></td>
<td>Interface with vehicle’s on-board computer.</td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>Record electronic diagnostic codes and trip/operational data.</td>
</tr>
<tr>
<td>61</td>
<td></td>
<td>Use relevant service information.</td>
</tr>
<tr>
<td>62</td>
<td></td>
<td>Replace electrical connector terminals, seals, and locks.</td>
</tr>
<tr>
<td>63</td>
<td></td>
<td>Inspect switches, sensors, controls, actuator components, and circuits.</td>
</tr>
<tr>
<td>64</td>
<td></td>
<td>Interpret customer programmable parameters.</td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>Perform on-engine inspections on electronic unit injectors (EUI).</td>
</tr>
<tr>
<td>66</td>
<td></td>
<td>Install EUI and related components.</td>
</tr>
<tr>
<td>67</td>
<td></td>
<td>Perform cylinder contribution test.</td>
</tr>
<tr>
<td>68</td>
<td></td>
<td>Perform on-engine inspections on hydraulic electronic unit injectors (HEUI) and system electronic controls.</td>
</tr>
<tr>
<td>69</td>
<td></td>
<td>Perform on-engine inspections on HEUI high-pressure oil supply and control systems.</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>Perform on-engine inspections on high-pressure common rail (HPCR) type injection systems.</td>
</tr>
<tr>
<td>71</td>
<td></td>
<td>Inspect high-pressure injection lines, hold downs, fittings and seals.</td>
</tr>
</tbody>
</table>

### DRIVE TRAIN

**Drive Train: Servicing Clutch**

<table>
<thead>
<tr>
<th>Task Number</th>
<th>8615</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td></td>
<td>Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems.</td>
</tr>
<tr>
<td>73</td>
<td></td>
<td>Inspect clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch.</td>
</tr>
<tr>
<td>74</td>
<td></td>
<td>Inspect hydraulic clutch slave and master cylinders, lines, and hoses.</td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>Inspect release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.</td>
</tr>
<tr>
<td>76</td>
<td></td>
<td>Inspect single-disc clutch pressure plate and clutch disc.</td>
</tr>
<tr>
<td>77</td>
<td></td>
<td>Inspect two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs.</td>
</tr>
<tr>
<td>78</td>
<td></td>
<td>Inspect clutch brake assembly.</td>
</tr>
<tr>
<td>79</td>
<td></td>
<td>Inspect self-adjusting/continuous-adjusting clutch mechanisms.</td>
</tr>
<tr>
<td>80</td>
<td></td>
<td>Inspect pilot bearing.</td>
</tr>
<tr>
<td>81</td>
<td></td>
<td>Reinstall flywheel.</td>
</tr>
<tr>
<td>82</td>
<td></td>
<td>Inspect flywheel and starter ring gear.</td>
</tr>
<tr>
<td>83</td>
<td></td>
<td>Inspect flywheel housing(s) to transmission housing/engine mating surface(s).</td>
</tr>
<tr>
<td>Task Number</td>
<td>8615</td>
<td>Tasks/Competencies</td>
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<tr>
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</tr>
<tr>
<td>84</td>
<td></td>
<td>Identify causes of transmission noise, shifting concerns, lockup, jumping-out-of-gear, overheating, and vibration problems.</td>
</tr>
<tr>
<td>85</td>
<td></td>
<td>Inspect air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies.</td>
</tr>
<tr>
<td>86</td>
<td></td>
<td>Inspect transmission mounts, insulators, and mounting bolts.</td>
</tr>
<tr>
<td>87</td>
<td></td>
<td>Inspect for leakage transmission cover plates, gaskets, seals, and cap bolts.</td>
</tr>
<tr>
<td>88</td>
<td></td>
<td>Check transmission fluid level and condition.</td>
</tr>
<tr>
<td>89</td>
<td></td>
<td>Inspect transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.</td>
</tr>
<tr>
<td>90</td>
<td></td>
<td>Reinstall transmission.</td>
</tr>
<tr>
<td>91</td>
<td></td>
<td>Inspect input shaft, gear, spacers, bearings, retainers, and slingers.</td>
</tr>
<tr>
<td>92</td>
<td></td>
<td>Inspect transmission oil filters, coolers and related components.</td>
</tr>
<tr>
<td>93</td>
<td></td>
<td>Inspect speedometer components.</td>
</tr>
<tr>
<td>94</td>
<td></td>
<td>Inspect power take-off (PTO) assemblies, controls, and shafts.</td>
</tr>
<tr>
<td>95</td>
<td></td>
<td>Inspect function of reverse light, neutral start, and warning device circuits.</td>
</tr>
<tr>
<td>96</td>
<td></td>
<td>Inspect transmission temperature gauge, wiring harnesses and sensor/sending unit.</td>
</tr>
<tr>
<td>97</td>
<td></td>
<td>Inspect operation of automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.</td>
</tr>
<tr>
<td>98</td>
<td></td>
<td>Inspect operation of automated mechanical transmission electronic shift selectors, air and electrical switches, displays and indicators, wiring harnesses, and air lines.</td>
</tr>
<tr>
<td>99</td>
<td></td>
<td>Diagnose automated mechanical transmission problems.</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td>Inspect operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.</td>
</tr>
<tr>
<td>101</td>
<td></td>
<td>Inspect operation of automatic transmission electronic shift selectors, switches, displays, indicators, and wiring harnesses.</td>
</tr>
<tr>
<td>102</td>
<td></td>
<td>Diagnose automatic transmission problems.</td>
</tr>
<tr>
<td>Drive Train: Driveshaft and Universal Joint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td></td>
<td>Identify causes of driveshaft and universal joint noise and vibration problems.</td>
</tr>
<tr>
<td>104</td>
<td></td>
<td>Inspect driveshaft, slip joints, yokes, drive flanges, and universal joints, driveshaft boots and seals, and retaining hardware.</td>
</tr>
<tr>
<td>105</td>
<td></td>
<td>Inspect driveshaft center support bearings and mounts.</td>
</tr>
<tr>
<td>Task Number</td>
<td>Tasks/Competencies</td>
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</tr>
<tr>
<td>106</td>
<td>Measure driveline angles.</td>
<td></td>
</tr>
<tr>
<td><strong>Drive Train: Drive Axle</strong></td>
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<td></td>
</tr>
<tr>
<td>107</td>
<td>Identify causes of drive axle(s) drive unit noise and overheating problems.</td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>Check fluid leaks.</td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>Check drive axle fluid level and condition.</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>Replace differential carrier assembly.</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>Replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings.</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Replace components of locking differential case assembly.</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore.</td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>Measure ring gear runout.</td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>Replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings.</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>Adjust drive pinion bearing preload.</td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>Adjust drive pinion depth.</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>Adjust side bearing preload and ring gear backlash.</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>Interpret ring gear and pinion tooth contact pattern.</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Replace ring gear thrust block/screw.</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>Inspect power divider (inter-axle differential) assembly.</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls.</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>Replace drive axle lubrication system.</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Replace drive axle shafts.</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>Replace wheel assembly.</td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Identify causes of drive axle wheel bearing noise.</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>Inspect drive axle temperature gauge, wiring harnesses, and sending unit/sensor.</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>Replace wheel bearings, seals and wear rings, and retaining hardware.</td>
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</tr>
<tr>
<td><strong>BRAKES</strong></td>
<td></td>
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<tr>
<td><strong>Brakes: Servicing Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC)</strong></td>
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<tr>
<td>129</td>
<td>Inspect ABS warning light operation.</td>
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</tr>
<tr>
<td>130</td>
<td>Diagnose ABS electronic control(s) and components.</td>
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</tr>
<tr>
<td>Task Number</td>
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<td>Tasks/Competencies</td>
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</tr>
<tr>
<td>131</td>
<td>+</td>
<td>Identify poor stopping and wheel lock-up problems caused by failure of the ABS.</td>
</tr>
<tr>
<td>132</td>
<td>+</td>
<td>Test operation of ABS air, hydraulic, electrical, and mechanical components.</td>
</tr>
<tr>
<td>133</td>
<td>+</td>
<td>Test ABS wheel speed sensors and circuits.</td>
</tr>
<tr>
<td>134</td>
<td>+</td>
<td>Bleed the ABS hydraulic circuits.</td>
</tr>
<tr>
<td>135</td>
<td>+</td>
<td>Observe ATC warning light operation.</td>
</tr>
<tr>
<td>136</td>
<td>+</td>
<td>Diagnose ATC electronic control(s) and components.</td>
</tr>
<tr>
<td>137</td>
<td>+</td>
<td>Verify power line carrier (PLC) operations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>SUSPENSION AND STEERING</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suspension and Steering: Steering Column</td>
</tr>
<tr>
<td>138</td>
<td>+</td>
<td>Install and center the steering wheel.</td>
</tr>
<tr>
<td>139</td>
<td>+</td>
<td>Enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suspension and Steering: Frame and Coupling Devices</td>
</tr>
<tr>
<td>140</td>
<td>+</td>
<td>Service fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware.</td>
</tr>
<tr>
<td>141</td>
<td>+</td>
<td>Service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.</td>
</tr>
<tr>
<td>142</td>
<td>+</td>
<td>Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage.</td>
</tr>
<tr>
<td>143</td>
<td>+</td>
<td>Inspect frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures.</td>
</tr>
<tr>
<td>144</td>
<td>+</td>
<td>Inspect pintle hooks and draw bars, if applicable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>ELECTRICAL/ELECTRONIC SYSTEMS</strong></td>
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<tr>
<td></td>
<td></td>
<td>Electrical/Electronic Systems: Servicing Gauges and Warning Devices</td>
</tr>
<tr>
<td>145</td>
<td>+</td>
<td>Verify instrument cluster operations using recommended electronic service tool(s).</td>
</tr>
<tr>
<td>146</td>
<td>+</td>
<td>Identify causes of data bus-driven gauge malfunctions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electrical/Electronic Systems: Servicing Related Electrical Systems</td>
</tr>
<tr>
<td>147</td>
<td>+</td>
<td>Perform diagnostic procedures using recommended electronic service tool(s).</td>
</tr>
<tr>
<td>148</td>
<td>+</td>
<td>Check operation of keyless and remote lock/unlock devices.</td>
</tr>
<tr>
<td>149</td>
<td>+</td>
<td>Identify causes of data bus communication problems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)</strong></td>
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<tr>
<td></td>
<td></td>
<td>Heating, Ventilation, and Air Conditioning: Servicing HVAC Systems</td>
</tr>
<tr>
<td>150</td>
<td>+</td>
<td>Verify the need for service or repair of HVAC systems based on unusual operating noises.</td>
</tr>
<tr>
<td>Task Number</td>
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<td>Tasks/Competencies</td>
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</tr>
<tr>
<td>151</td>
<td>+</td>
<td>Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions.</td>
</tr>
<tr>
<td>152</td>
<td>+</td>
<td>Conduct performance test(s) on HVAC systems.</td>
</tr>
<tr>
<td>153</td>
<td>+</td>
<td>Retrieve diagnostic codes.</td>
</tr>
</tbody>
</table>

Heating, Ventilation, and Air Conditioning (A/C): Servicing Air Conditioning (A/C) System and Components, General

<table>
<thead>
<tr>
<th>Task Number</th>
<th>+</th>
<th>Identify causes of temperature control problems in the A/C system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>154</td>
<td>+</td>
<td>Check for contamination of refrigerant and lubricant.</td>
</tr>
<tr>
<td>155</td>
<td>+</td>
<td>Identify A/C system problems indicated by pressure gauge and temperature readings.</td>
</tr>
<tr>
<td>157</td>
<td>+</td>
<td>Identify A/C system problems indicated by visual, audible, smell, and touch procedures.</td>
</tr>
<tr>
<td>158</td>
<td>+</td>
<td>Perform A/C system leak test.</td>
</tr>
<tr>
<td>159</td>
<td>+</td>
<td>Recharge A/C system using appropriate equipment.</td>
</tr>
<tr>
<td>160</td>
<td>+</td>
<td>Identify contamination in the A/C system components.</td>
</tr>
<tr>
<td>161</td>
<td>+</td>
<td>Perform diagnostic procedures using recommended electronic service tool(s).</td>
</tr>
</tbody>
</table>

Heating, Ventilation, and Air Conditioning: Servicing Compressor and Clutch

<table>
<thead>
<tr>
<th>Task Number</th>
<th>+</th>
<th>Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>162</td>
<td>+</td>
<td>Replace A/C system pressure, thermal, and electronic devices.</td>
</tr>
<tr>
<td>164</td>
<td>+</td>
<td>Replace A/C compressor drive belts, pulleys, and tensioners.</td>
</tr>
<tr>
<td>165</td>
<td>+</td>
<td>Service A/C compressor clutch components or assembly.</td>
</tr>
<tr>
<td>166</td>
<td>+</td>
<td>Correct A/C compressor lubricant level (if applicable).</td>
</tr>
<tr>
<td>167</td>
<td>+</td>
<td>Replace A/C compressor.</td>
</tr>
<tr>
<td>168</td>
<td>+</td>
<td>Replace A/C compressor mountings and hardware.</td>
</tr>
</tbody>
</table>

Heating, Ventilation, and Air Conditioning: Servicing Evaporator, Condenser, and Related Components

<table>
<thead>
<tr>
<th>Task Number</th>
<th>+</th>
<th>Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses.</th>
</tr>
</thead>
<tbody>
<tr>
<td>169</td>
<td>+</td>
<td>Inspect A/C system hoses, lines, filters, fittings, and seals.</td>
</tr>
<tr>
<td>171</td>
<td>+</td>
<td>Test A/C system condenser.</td>
</tr>
<tr>
<td>172</td>
<td>+</td>
<td>Replace receiver/drier or accumulator/drier.</td>
</tr>
<tr>
<td>173</td>
<td>+</td>
<td>Test cab/sleeper refrigerant solenoid, expansion valve(s), and thermal bulb (capillary tube).</td>
</tr>
<tr>
<td>174</td>
<td>+</td>
<td>Replace orifice tube.</td>
</tr>
<tr>
<td>175</td>
<td>+</td>
<td>Test cab/sleeper evaporator core.</td>
</tr>
<tr>
<td>Task Number</td>
<td>Tasks/Competencies</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>176</td>
<td>Repair evaporator housing and water drain.</td>
<td></td>
</tr>
<tr>
<td>177</td>
<td>Inspect A/C system service ports (gauge connections).</td>
<td></td>
</tr>
<tr>
<td>178</td>
<td>Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device.</td>
<td></td>
</tr>
</tbody>
</table>

**Heating, Ventilation, and Air Conditioning: Servicing Heating and Engine Cooling Systems**

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>179</td>
<td>Identify causes of outlet air temperature control problems in the HVAC system.</td>
</tr>
<tr>
<td>180</td>
<td>Identify window fogging problems.</td>
</tr>
<tr>
<td>181</td>
<td>Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration.</td>
</tr>
<tr>
<td>182</td>
<td>Inspect engine cooling and heating system hoses, lines, and clamps.</td>
</tr>
<tr>
<td>183</td>
<td>Inspect and test radiator, pressure cap, and coolant recovery system (surge tank).</td>
</tr>
<tr>
<td>184</td>
<td>Inspect water pump.</td>
</tr>
<tr>
<td>185</td>
<td>Inspect and test thermostats, by-passes, housings, and seals.</td>
</tr>
<tr>
<td>186</td>
<td>Refill with recommended coolant/additive package.</td>
</tr>
<tr>
<td>187</td>
<td>Inspect thermostatic cooling fan system (i.e., hydraulic, pneumatic, and electronic) and fan shroud.</td>
</tr>
<tr>
<td>188</td>
<td>Test heating system coolant control valve(s) and manual shut-off valves.</td>
</tr>
<tr>
<td>189</td>
<td>Inspect heater core.</td>
</tr>
</tbody>
</table>

**Heating, Ventilation, and Air Conditioning: Servicing Electrical Operating Systems and Related Controls**

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>Identify causes of HVAC electrical control system problems.</td>
</tr>
<tr>
<td>191</td>
<td>Test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices.</td>
</tr>
<tr>
<td>192</td>
<td>Test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices.</td>
</tr>
<tr>
<td>193</td>
<td>Test A/C related electronic engine control systems.</td>
</tr>
<tr>
<td>194</td>
<td>Test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices.</td>
</tr>
<tr>
<td>195</td>
<td>Test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices.</td>
</tr>
<tr>
<td>196</td>
<td>Test HVAC system electrical/electronic control panel assemblies.</td>
</tr>
<tr>
<td>197</td>
<td>Perform diagnostic procedures using recommended electronic service tool(s).</td>
</tr>
</tbody>
</table>

**Heating, Ventilation, and Air Conditioning: Servicing Air/Mechanical Operating Systems and Related Controls**
<table>
<thead>
<tr>
<th>Task Number</th>
<th>8615</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>198</td>
<td>+</td>
<td>Identify causes of HVAC air and mechanical control problems.</td>
</tr>
<tr>
<td>199</td>
<td>+</td>
<td>Test HVAC system air and mechanical control panel assemblies.</td>
</tr>
<tr>
<td>200</td>
<td>+</td>
<td>Adjust HVAC system air and mechanical control cables and linkages.</td>
</tr>
<tr>
<td>201</td>
<td>+</td>
<td>Test HVAC system actuators and hoses.</td>
</tr>
<tr>
<td>202</td>
<td>+</td>
<td>Adjust HVAC system ducts, doors, and outlets.</td>
</tr>
<tr>
<td>Heating, Ventilation, and Air Conditioning: Handling Refrigerant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>203</td>
<td>+</td>
<td>Verify correct operation of certified equipment.</td>
</tr>
<tr>
<td>204</td>
<td>+</td>
<td>Recover A/C system refrigerant.</td>
</tr>
<tr>
<td>205</td>
<td>+</td>
<td>Recycle or properly dispose of refrigerant.</td>
</tr>
<tr>
<td>206</td>
<td>+</td>
<td>Store refrigerant.</td>
</tr>
<tr>
<td>207</td>
<td>+</td>
<td>Test recycled refrigerant for non-condensable gases.</td>
</tr>
<tr>
<td>PREVENTIVE MAINTENANCE AND INSPECTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preventive Maintenance and Inspection: Servicing Cab and Hood Instruments and Controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>208</td>
<td>+</td>
<td>Check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems).</td>
</tr>
<tr>
<td>HYDRAULICS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydraulics: Servicing General System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>209</td>
<td>+</td>
<td>Identify system type (closed and open) and proper operation.</td>
</tr>
<tr>
<td>210</td>
<td>+</td>
<td>Interpret system diagrams and schematics.</td>
</tr>
<tr>
<td>211</td>
<td>+</td>
<td>Perform system temperature, pressure, flow, and cycle time tests.</td>
</tr>
<tr>
<td>212</td>
<td>+</td>
<td>Verify placement of equipment/component safety labels and placards.</td>
</tr>
<tr>
<td>Hydraulics: Servicing Pumps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>+</td>
<td>Identify system fluid type.</td>
</tr>
<tr>
<td>214</td>
<td>+</td>
<td>Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems.</td>
</tr>
<tr>
<td>215</td>
<td>+</td>
<td>Determine pump type, rotation, and drive system.</td>
</tr>
<tr>
<td>216</td>
<td>+</td>
<td>Install pump.</td>
</tr>
<tr>
<td>217</td>
<td>+</td>
<td>Inspect pump inlet for restrictions and leaks.</td>
</tr>
<tr>
<td>218</td>
<td>+</td>
<td>Inspect pump outlet for restrictions and leaks.</td>
</tr>
<tr>
<td>Hydraulics: Servicing Filtration/Reservoirs (Tanks)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>219</td>
<td>+</td>
<td>Identify type of filtration system and flow direction.</td>
</tr>
<tr>
<td>220</td>
<td>+</td>
<td>Service filters and breathers.</td>
</tr>
<tr>
<td>221</td>
<td>+</td>
<td>Identify causes of system contamination.</td>
</tr>
<tr>
<td>222</td>
<td>+</td>
<td>Take a hydraulic oil sample for analysis.</td>
</tr>
<tr>
<td>Task Number</td>
<td>8615</td>
<td>Tasks/Competencies</td>
</tr>
<tr>
<td>-------------</td>
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<td>--------------------</td>
</tr>
<tr>
<td>223</td>
<td>+</td>
<td>Check reservoir fluid level and condition.</td>
</tr>
<tr>
<td>224</td>
<td>+</td>
<td>Repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines.</td>
</tr>
</tbody>
</table>

Hydraulics: Servicing Hoses, Fittings, and Connections

<table>
<thead>
<tr>
<th>Task Number</th>
<th></th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>225</td>
<td>+</td>
<td>Diagnose causes of component leakage, damage, and restriction.</td>
</tr>
<tr>
<td>226</td>
<td>+</td>
<td>Inspect hoses and connections (length, size, routing, bend radii, and protection).</td>
</tr>
<tr>
<td>227</td>
<td>+</td>
<td>Assemble hoses, tubes, connections and fittings in accordance with manufacturer’s specifications.</td>
</tr>
<tr>
<td>228</td>
<td>+</td>
<td>Inspect fitting seals and sealants.</td>
</tr>
</tbody>
</table>

Hydraulics: Servicing Control Valves

<table>
<thead>
<tr>
<th>Task Number</th>
<th></th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>229</td>
<td>+</td>
<td>Pressure test system safety relief valve.</td>
</tr>
<tr>
<td>230</td>
<td>+</td>
<td>Perform control valve operating pressure and flow tests.</td>
</tr>
<tr>
<td>231</td>
<td>+</td>
<td>Test valve controls (i.e., electrical/electronic, mechanical, pneumatic).</td>
</tr>
<tr>
<td>232</td>
<td>+</td>
<td>Identify causes of control valve leakage (internal/external).</td>
</tr>
<tr>
<td>233</td>
<td>+</td>
<td>Inspect pilot control valve linkages, cables, and power take-off (PTO) controls.</td>
</tr>
</tbody>
</table>

Hydraulics: Servicing Actuators

<table>
<thead>
<tr>
<th>Task Number</th>
<th></th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>234</td>
<td>+</td>
<td>Identify actuator type.</td>
</tr>
<tr>
<td>235</td>
<td>+</td>
<td>Identify the cause of seal failure.</td>
</tr>
<tr>
<td>236</td>
<td>+</td>
<td>Identify the cause of incorrect actuator movement and leakage (internal and external).</td>
</tr>
<tr>
<td>237</td>
<td>+</td>
<td>Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage.</td>
</tr>
<tr>
<td>238</td>
<td>+</td>
<td>Repair and/or replace actuators in accordance with manufacturers' recommended procedures.</td>
</tr>
<tr>
<td>239</td>
<td>+</td>
<td>Inspect actuators for dents, cracks, damage, and leakage.</td>
</tr>
<tr>
<td>240</td>
<td>+</td>
<td>Purge and/or bleed system in accordance with manufacturers' recommended procedures.</td>
</tr>
</tbody>
</table>

Legend: ☑Essential ☐Non-essential ❋Omitted

**Curriculum Framework**
REQUIRED SUPPLEMENTAL TASKS

Practicing Lab/Shop and Personal Safety

Task Number 39

Identify general lab/shop safety rules and procedures.

Definition

Identification should include

- wearing correct protective eyewear and clothing
- following all Occupational Safety and Health Administration (OSHA) standards for the task performed
- following the lab/shop rules set by the local school board.

Process/Skill Questions

- Why is eye protection important in the diesel lab/shop?
- Why should you follow OSHA guidelines when performing service on a diesel vehicle?

Task Number 40

Utilize safe procedures for handling of tools and equipment.

Definition

Utilization should include always reading the manufacturer procedures for the safe use of hand tools, power tools, and equipment.

Process/Skill Questions

- Why should you always read manufacturer procedures for the proper use of the tool?

Task Number 41

Identify and use proper placement of floor jacks and jack stands.
Definition

Identification should include

- following manufacturer recommendations for jack placement
- ensuring the vehicle is on level ground before jacking
- using jacks and jack stands that are rated for the capacity for the vehicle on which the service is to be performed.

Process/Skill Questions

- Why should you check for proper jack placement?
- Why should you use jack stands to support a vehicle?

Task Number 42

Identify and use proper procedures for safe lift operation.

Definition

Procedure should include

- reviewing all lift-safety information
- identifying the correct placement of lift arms on vehicle
- lowering vehicle on safety locks before performing under-carriage service.

Process/Skill Questions

- Why is it important to read all lift-safety material supplied by the lift manufacturer?
- Why is it important to lower the vehicle onto the safety locks?

Task Number 43

Utilize proper ventilation procedures for working within the lab/shop area.

Definition

Utilization should include

- keeping bay doors open when possible
- operating lab/shop exhaust fans
- using an exhaust ventilation hose on running vehicles.
Process/Skill Questions

- What are the gases emitted by a running vehicle?
- Why is proper ventilation so important?
- What are the dangers of a running vehicle in a confined space?

Task Number 44

Identify marked safety areas.

Definition

Identification should include describing and translating signage and special markings (e.g., floor paint) that identify work and caution areas.

Process/Skill Questions

- What are the different types of work zones?
- How do you know if additional safety equipment or clothing is needed to enter a safety area?
- How are walkways identified in the lab/shop area?

Task Number 45

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.

Definition

Identification should include

- the different types of fires encountered in the diesel technology field (Classes A, B, C, D, and E) and the hazards and the precautions associated with each type of fire
- the locations and types fire safety equipment including the appropriate type of extinguishers and their use and identification of relevant signage and labels
- fire emergency procedures in accordance with government regulations, building specifications, and instructor's guidelines.

Process/Skill Questions

- How are fire extinguishers locations marked?
What types of extinguishers are used in the diesel lab/shop?
What other fire safety equipment might be found in a diesel lab/shop?

Task Number 46

Identify the location and use of eye wash stations.

Definition

Identification should include describing the signage and operating procedures for the unit.

Process/Skill Questions

- What is the color of the sign that signifies an eye wash station?
- When should you use an eye wash station?
- What safety equipment provides additional eye protection?

Task Number 47

Identify the location of the posted evacuation routes.

Definition

Identification should include

- events that could trigger an evacuation
- the location and interpretation of the posted evacuation route
- the destination and procedures for evacuation.

Process/Skill Questions

- What route should be followed in the event of an evacuation?
- Where is the evacuation route posted?
- Why is it important to establish a meeting place in the case of an evacuation?

Task Number 48

Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.

Definition
Compliance should include

- wearing safety glasses at all times in the diesel lab/shop area
- wearing additional personal safety equipment, when necessary
- adhering to governmental and classroom safety policies.

Process/Skill Questions

- Why are safety glasses in the diesel lab/shop required at all times?
- What kinds of shoes are appropriate in the lab/shop area?
- Why might you need to wear ear protection in the diesel lab/shop?

Task Number 49

**Identify and wear appropriate clothing for lab/shop activities.**

**Definition**

Identification should include

- clothing that will not hinder operations or be a danger to self or others
- school or lab/shop policy
- professional dress requirements and professional expectations.

Process/Skill Questions

- What can result from wearing loose clothing around moving objects in the lab/shop?
- What is the school dress code?
- What are the benefits of following standard workplace policies for apparel in the lab/shop?

Task Number 50

**Secure hair and jewelry for lab/shop activities.**

**Definition**

Compliance should include

- restraining hair to keep it from inadvertently getting caught in moving parts
- restraining or not wearing jewelry that can short circuit electrical components, cause electrical burns, or get caught in moving parts
• adhering to lab/shop safety policies.

Process/Skill Questions

• What is your lab/shop’s policy concerning hair safety?
• Why should long hair be tied up?
• What is the best way to secure your hair so that it does not cause serious injury?

Task Number 51

Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits.

Definition

Demonstration should include following manufacturer guidelines when working with SRS, electronic brake control systems, and hybrid vehicle high voltage circuits. When working with hybrid vehicles, workers should be able to identify

• location of the battery
• physical appearance of the disconnects (small, plastic pieces that fit into the side of a hybrid battery)
• location of high voltage circuits, according to service materials and manufacturer guidelines
• specific protective gear and clothing that technicians should wear when working with the service plug (i.e., type 00 insulating/voltage gloves).

Process/Skill Questions

• Why is it important to follow manufacturer guidelines when disabling an SRS?
• What could happen if the airbag deploys at the wrong time?
• What precautions should be taken when handling removed airbags?
• What are the components of electronic brake control systems?
• What are the types of electronic brake control systems?
• How does the wheel speed sensor operate?
• What color are the high voltage circuits?
• What are the shock dangers involving electric/hybrid vehicles?
• What is the electrocution threshold for humans?

Task Number 52
Demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge [HID] lamps, ignition systems, injection systems, etc.).

Definition

Demonstration should include identifying the manufacturer's warning and guidelines regarding shock hazard.

Process/Skill Questions

- What is the typical system voltage of a HID headlight?
- What gas is used in most HID bulbs?
- What do HID bulbs use in place of filaments?

Task Number 53

Demonstrate knowledge of safety data sheets' (SDS) location and content.

Definition

Demonstration should include identifying

- the location of the sheets within the lab/shop and the purpose they serve
- the administration's (ownership's) responsibility for workers' health and safety
- laws/regulations and practices affecting workers' health and safety
- health and safety hazards
- health and safety programs
- the responsibility for environmental stewardship
- environmental laws, regulations, and practices
- sustainability initiatives.

Process/Skill Questions

- What environmental concerns should an industry address?
- What environmentally-friendly practices and resources are available to an industry?
- What methods can be used to motivate employees to become involved in effective health, safety, and environmental practices?

DIESEL ENGINES
Diesel Engines: Servicing Air Induction and Exhaust Systems

Task Number 54

Inspect exhaust after treatment devices.

Definition

Inspection should include visual inspection of after-treatment components per manufacturer.

Process/Skill Questions

• What is the purpose of the exhaust after-treatment devices?

Diesel Engines: Servicing Fuel Supply System

Task Number 55

Inspect fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, engine control module (ECM) cooling plates, and mounting hardware.

Definition

Inspection should include

• checking fuel pressure with a scan tool per manufacturer
• draining water separator and checking for leaks
• checking connections on fuel heater base for coolant leaks
• cleaning ECM of oil and debris to aid in cooling the electronics
• tightening all hardware
• determining additional needed action.

Process/Skill Questions

• What happens if the water separator is not drained regularly?
• What is the purpose of a fuel oil heater?
• What liquid is used to cool the ECM?

Task Number 56

Inspect pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings).

Definition

Inspection should include following manufacturer's instructions for checking the fuel pressure regulator system.

Process/Skill Questions

• What are the various methods/components that manufacturer's use to help regulate fuel pressure?
• What could cause a low fuel pressure complaint?

Task Number 57

Check fuel system for air.

Definition

Checking should include

• priming and bleeding fuel system
• following manufacturer's procedure for removing air from the fuel system
• installing in-line clear tube to view air trapped in the fuel lines
• verifying operation of manual or electric priming pump.

Process/Skill Questions

• What problems will air in the fuel system cause?
• Should a fuel filter be installed empty or filled with fuel?

Diesel Engines: Servicing Electronic Fuel Management System

Task Number 58
Inspect power and ground circuits and connections.

**Definition**

Inspection should include

- using a digital multimeter (DMM)
- following the manufacturer’s troubleshooting guide and electrical schematics
- diagnosing the functionality of the electronic fuel management system.

**Process/Skill Questions**

- What affect does corrosion cause on the pins of a wiring harness when evaluating an electrical circuit?

**Task Number 59**

**Interface with vehicle’s on-board computer.**

**Definition**

Interfacing should include

- connecting electronic technician (ET) software to the engine ECM for complete diagnostic evaluation
- using PC-based software and scan tools
- following manufacturer’s guidelines and troubleshooting process
- determining needed action.

**Process/Skill Questions**

- Although each manufacturer has a different set of software for their engine, what are the common system checks that all software systems analyze?

**Task Number 60**

**Record electronic diagnostic codes and trip/operational data.**

**Definition**

Recording should include

- monitoring electronic data
• recording static and dynamic engine results
• comparing results with manufacturer troubleshooting guidelines
• taking corrective action
• clearing all fault codes
• verifying that system is operating properly.

Process/Skill Questions

• Why is the diagnostic software password-protected?

Task Number 61

Use relevant service information.

Definition

Using service information should include

• locating appropriate service literature (e.g., diagnostic procedures, flow charts, wiring diagrams) both on paper and in an electronic format
• understanding different terminology and format of the service information from one manufacturer to another
• troubleshooting problems using wiring schematics and manufacturer's troubleshooting charts.

Process/Skill Questions

• Although software may be different, what basic troubleshooting steps would you take to correct an engine performance problem?

Task Number 62

Replace electrical connector terminals, seals, and locks.

Definition

Replacing should include

• identifying the various types of connectors found on the engine
• performing both a visual, hands-on evaluation of the electrical connectors on the engine
• demonstrating the use of the service tools for repairing each type of connector.

Process/Skill Questions
• What are four different styles of electrical connectors?
• What are the pros and cons of each?
• Why do manufacturers use different styles of electrical connectors on different components?

Task Number 63

Inspect switches, sensors, controls, actuator components, and circuits.

Definition

Inspection should include

• locating the test/operational specifications for all electrical components in the manufacture’s service literature
• using a DMM or other testing devices to evaluate the components against the standard operating specifications
• making adjustments or replacements as needed.

Process/Skill Questions

• What basic troubleshooting skills/procedures are used in evaluating all of the electrical components?
• Are the electrical components serviceable or must they be replaced if they are out of specification?

Task Number 64

Interpret customer programmable parameters.

Definition

Interpretation should include

• following manufacturer's guidelines to determine which functions can be programmed to meet the operator's needs
• connecting computer system to view and or change desired settings.

Process/Skill Questions

• Why do some functions require a password to either activate on or deactivate?
Task Number 65

**Perform on-engine inspections on electronic unit injectors (EUI).**

**Definition**

Performance should include

- visual inspection of EUI wires, solenoids, rocker arms, and valves
- check of injector rocker arm clearance
- necessary adjustments.

**Process/Skill Questions**

- If the rocker arm adjust is incorrect, what effect would it have on the injector?
- What might cause one injector solenoid to fail?

Task Number 66

**Install EUI and related components.**

**Definition**

Installation should include

- following manufacturer's guidelines
- using the specialized tooling for the removal and installation of the EUI
- recalibrating the ECM (if applicable).

**Process/Skill Questions**

- Why may you need to recalibrate the ECM if new injectors are installed?
- What is the purpose of the TRIM code on a new injector?
- What is the purpose of the injector O rings?

Task Number 67

**Perform cylinder contribution test.**

**Definition**
Performance should include

- using electronic service tools
- following manufacturer's procedure for checking the relative compression of each cylinder.

**Process/Skill Questions**

- What is the purpose of running a cylinder contribution test?
- What might cause one cylinder to have lower compression than the other cylinders?

**Task Number 68**

**Perform on-engine inspections on hydraulic electronic unit injectors (HEUI) and system electronic controls.**

**Definition**

Performance should include

- visual inspection of EUI wires, solenoids, rocker arms, and valves
- check of injector rocker arm clearance
- necessary adjustments.

**Process/Skill Questions**

- If the rocker arm adjust is incorrect, what effect would it have on the injector?
- What might cause one injector solenoid to fail?

**Task Number 69**

**Perform on-engine inspections on HEUI high-pressure oil supply and control systems.**

**Definition**

Performance should include

- following manufacturer's procedure for testing HEUI on-engine
- inspecting for oil leaks
- inspecting for wiring harness problems
- determining needed action.
Process/Skill Questions

- Could low injector activation pressure cause a no-start? Why?
- Could a low engine oil level cause a HEUI problem? How?

Task Number 70

Perform on-engine inspections on high-pressure common rail (HPCR) type injection systems.

Definition

Performance should include

- following all safety guidelines
- inspecting EUI wires, solenoids, rocker arms, and valves
- checking injector rocker arm clearance
- making necessary adjustments.

Process/Skill Questions

- If the rocker arm adjustment is incorrect, what effect would it have on the injector?
- What might cause one injector solenoid to fail?

Task Number 71

Inspect high-pressure injection lines, hold downs, fittings and seals.

Definition

Inspection should include

- visual inspecting all high-pressure fuel components
- checking the torque on all fittings and bolts associated with the HPCR
- determining needed action.

Process/Skill Questions

- Why are the hold-down clamps so critical in a HPCR system?

DRIVE TRAIN
Drive Train: Servicing Clutch

Task Number 72

**Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems.**

**Definition**

Inspection should include

- checking the clutch components
- test driving the vehicle to verify operation
- determining needed action.

**Process/Skill Questions**

- What type of transmission/clutch is the vehicle equipped with?
- What is the proper clutch pedal free travel?
- What is the proper spacing between the clutch brake and release bearing?

Task Number 73

**Inspect clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch.**

**Definition**

Inspection should include

- checking linkage for wear and cables for fraying
- checking for missing springs
- determining whether the vehicle will start without clutch pedal depressed
- checking the clutch release for stick or bind
- determining needed action.

**Process/Skill Questions**

- What are the manufacture free travel guidelines?
- What is the purpose of the clutch safety switch?
- Where are the lube points on the transmission?
Task Number 74
Inspect hydraulic clutch slave and master cylinders, lines, and hoses.

Definition

Inspection should include

- checking for fluid leaks
- confirming proper fluid levels
- checking condition of lines and hoses
- determining needed action.

Process/Skill Questions

- What would occur if the system was low on hydraulic fluid?

Task Number 75
Inspect release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.

Definition

Inspection should include

- checking the system for excessive wear
- following manufacturer's specifications for adjustments and lubrication
- determining needed actions.

Process/Skill Questions

- What effect will excessive component wear have on clutch operation?
- What is the proper adjustment of the throw out bearing?
- How will fluid leaks affect clutch operation?

Task Number 76
Inspect single-disc clutch pressure plate and clutch disc.
Definition

Inspection should include

- checking pressure plate and clutch disk for wear according to manufacturer's guidelines
- determining needed action.

Process/Skill Questions

- How does the pressure plate and clutch disk operate?

Task Number 77

Inspect two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs.

Definition

Inspection should include

- checking pads for wear and discoloration
- checking for missing and worn springs
- checking condition of drive pins and lugs
- determining needed action.

Process/Skill Questions

- How will worn clutch pads affect operation?
- What problem might a missing or broken spring cause during operation?

Task Number 78

Inspect clutch brake assembly.

Definition

Inspection should include

- verifying clutch brake condition
- checking input shaft and bearing retainer
- performing needed action.

Process/Skill Questions
• What operation will be affected if the friction material is missing on the clutch brake?
• What would be the result of a missing clutch brake?

Task Number 79

Inspect self-adjusting/continuous-adjusting clutch mechanisms.

Definition

Inspection should include

• verifying that adjustment is within manufacturer's specifications
• making adjustments or replacements as needed.

Process/Skill Questions

• What is the purpose of a self-adjusting/continuous adjusting clutch?
• How is the proper operation of self-adjusting/continuous adjusting clutch mechanisms verified?

Task Number 80

Inspect pilot bearing.

Definition

Follow manufacturer's guidelines for pilot bearing inspection.

Process/Skill Questions

• What effect will the pilot bearing have on the input shaft?

Task Number 81

Reinstall flywheel.

Definition

Reinstalling should include

• removing the flywheel
• inspecting mounting area on the crankshaft and rear main oil seal
• measuring crankshaft end play
• installing the flywheel according to manufacturer's instructions.

Process/Skill Questions

• What might occur if the flywheel is installed reversed?
• What might be caused by an improperly torqued flywheel?

Task Number 82

Inspect flywheel and starter ring gear.

Definition

Inspection should include

• measuring the flywheel face and pilot bore runout with a micrometer
• determining flywheel wear condition
• checking for damaged ring gear teeth
• determining needed action.

Process/Skill Questions

• What is the allowable wear of a flywheel?
• How might a damaged ring gear affect the starting system?

Task Number 83

Inspect flywheel housing(s) to transmission housing/engine mating surface(s).

Definition

Inspection should include

• checking for cracks, oblong bolt holes, and overall condition
• checking for oil leaks within the housing
• measuring flywheel housing face and bore runout
• determining needed action.

Process/Skill Questions
• What might be the cause of oil leaks within the bell housing?

Drive Train: Servicing Transmission

Task Number 84

Identify causes of transmission noise, shifting concerns, lockup, jumping-out-of-gear, overheating, and vibration problems.

Definition

Identification should include

• following the manufacturer’s troubleshooting guide for proper transmission operation
• determining needed action.

Possible causes may include

• improper clutch adjustment
• loss of fluid
• broken clutch plate spring
• low oil level
• worn clutch control parts.

Process/Skill Questions

• What is the cause of low/no transmission oil?
• What are the signs of worn clutch disk/flywheel?

Task Number 85

Inspect air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies.

Definition

Inspection should include

• test driving to determine proper operation
• determining needed repairs or replacements.
Process/Skill Questions

• What would be the result of a sticking range selector?

**Task Number 86**

**Inspect transmission mounts, insulators, and mounting bolts.**

**Definition**

Inspection should include

• visually checking all mountings for missing or worn bushings
• visually checking the bell housing for missing bolts and worn bolt holes
• making replacements as needed.

Process/Skill Questions

• What is the function of the transmission mounts?

**Task Number 87**

**Inspect for leakage transmission cover plates, gaskets, seals, and cap bolts.**

**Definition**

Inspection should include

• checking the transmission assembly for leakage
• replacing parts
• determining needed action.

Process/Skill Questions

• If oil is leaking from the rear of the transmission what seal needs replacing?

**Task Number 88**

**Check transmission fluid level and condition.**

**Definition**
Checking should include

- visually inspecting oil level and condition following manufacturer's instructions
- adding lubricant if needed
- determining additional service as needed.

Process/Skill Questions

- What does metal in the fluid indicate?

Task Number 89

Inspect transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.

Definition

Inspection should include

- test driving vehicle to assess operation
- visually inspecting all components for fit and installation
- making adjustments and replacements as needed
- determining additional needed action.

Process/Skill Questions

- How would a shifter missing a detent ball or spring operate?

Task Number 90

Reinstall transmission.

Definition

Reinstallation should include

- removing transmission
- installing transmission according to manufacturer's guidelines.

Process/Skill Questions

- What would be the consequences of installing a transmission with a cracked bellhousing?
Task Number 91

Inspect input shaft, gear, spacers, bearings, retainers, and slingers.

Definition

Inspection should include

- checking input shaft for end play and wear
- visually verifying all gears are intact and not discolored
- determining needed action.

Process/Skill Questions

- What are oil slingers, and what is their purpose?

Task Number 92

Inspect transmission oil filters, coolers and related components.

Definition

Inspection should include

- checking for the proper oil filter for the application
- looking for oil leaks
- making replacements as needed.

Process/Skill Questions

- What failure could result from a leaking oil cooler?

Task Number 93

Inspect speedometer components.

Definition

Inspection should include
• test driving the vehicle to verify speedometer operation
• determining needed action.

Process/Skill Questions

• How do you test a speedometer for proper operation during road test?

Task Number 94

Inspect power take-off (PTO) assemblies, controls, and shafts.

Definition

Inspection should include

• verifying operation per manufacture instructions
• visually checking components for leaks
• verifying that shaft and U joints are within tolerance
• determining needed action.

Process/Skill Questions

• What is the process for determining the proper shim specification for mounting the PTO?

Task Number 95

Inspect function of reverse light, neutral start, and warning device circuits.

Definition

Inspection should include

• visually checking the operation of the systems
• determining needed action.

Process/Skill Questions

• Should the vehicle start with vehicle in gear or the clutch not depressed? Explain.

Task Number 96
Inspect transmission temperature gauge, wiring harnesses and sensor/sending unit.

Definition

Inspection should include

- visually checking the wiring harness
- testing operation of the temperature gauge
- using a volt/ohm meter to verify proper operation
- determining needed action.

Process/Skill Questions

- Where is the transmission temperature sensor located?
- How will a sending unit react with a short to ground?

Task Number 97

Inspect operation of automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.

Definition

Inspection should include

- following original equipment manufacturer (OEM) guidelines for proper troubleshooting steps
- test driving unit to verify proper operation.

Process/Skill Questions

- How would you verify faults in an automated transmission?
- Would low voltage cause shifting/performance issues?
- How would a short to ground affect voltage?

Task Number 98
Inspect operation of automated mechanical transmission electronic shift selectors, air and electrical switches, displays and indicators, wiring harnesses, and air lines.

Definition

Inspection should include

- following OEM guidelines for proper troubleshooting steps
- test driving unit to verify proper operation.

Process/Skill Questions

- How would you verify faults in an automated transmission?
- Would low voltage cause shifting/performance issues?
- How would a short to ground affect voltage?
- Could low air pressure cause shifting issues?

Task Number 99

Diagnose automated mechanical transmission problems.

Definition

Diagnosis should include following manufacturer troubleshooting guidelines for all troubleshooting.

Verify customer complaint, using the three W's:

- When did you first notice the issue?
- Where were you when it occurred?
- What did you feel, smell, and hear?

Task Number 100

Inspect operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.
Task Number 101

Inspect operation of automatic transmission electronic shift selectors, switches, displays, indicators, and wiring harnesses.

Definition

Inspection should include

- reference to OEM instruction for proper troubleshooting steps
- inspection of shifter for proper operation and lighting according to the OEM
- verification that all harnesses are in good condition as part of the inspection.

Process/Skill Questions

- What would a flashing electronic shifter indicate?
- What would a blank shifter indicate?

Task Number 102

Diagnose automatic transmission problems.

Definition

Diagnosis should include

- reference to manufacturer troubleshooting guidelines for all troubleshooting
- verification of customer complaint, using the three Ws:
  - When did you first notice the issue?
Where were you when it occurred?
What did you feel, smell, and hear?

Process/Skill Questions

- What automatic transmission problems should be addressed immediately, before the vehicle is driven again?
- What different smells might be associated with transmission problems?

Drive Train: Driveshaft and Universal Joint

Task Number 103

Identify causes of driveshaft and universal joint noise and vibration problems.

Definition

Identification should include

- inspecting driveshaft and universal joint condition
- test driving the vehicle to feel for cause of vibration
- determining needed action.

Process/Skill Questions

- What are the signs of a failed universal joint?
- Why are there grease fittings on the drive shaft slip joints?

Task Number 104

Inspect driveshaft, slip joints, yokes, drive flanges, and universal joints, driveshaft boots and seals, and retaining hardware.

Definition

Inspection should include

- checking for torn rubber components
- checking for excessive oil or grease
• confirming there is no excessive play in the drive train components
• determining whether to service or replace.

Process/Skill Questions

• What impact will a missing driveshaft boot have on the driveshaft?
• What damage will occur as a result of a failed universal joint?

Task Number 105

Inspect driveshaft center support bearings and mounts.

Definition

Inspection should include

• checking brackets for straightness
• checking rubber bushing for movement and condition
• determining needed action.

Process/Skill Questions

• What impact will a missing driveshaft boot have on the driveshaft?
• What damage will occur as a result of a failed universal joint?

Task Number 106

Measure driveline angles.

Definition

Measurement should include

• following manufacturer's guidelines
• using an angle analyzer
• determining needed action?

Process/Skill Questions

• Where can driveline angle specifications be found?

Drive Train: Drive Axle
Task Number 107

Identify causes of drive axle(s) drive unit noise and overheating problems.

Definition

Identification should include

- checking for oil contamination of the axle housing
- verifying any external oil leaks
- determining needed action.

Process/Skill Questions

- What might excessive oil on the inner or outer wheel indicate?
- What can result from lack of lube to a wheel end?

Task Number 108

Check fluid leaks.

Definition

Checking should include

- inspecting drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals
- confirming proper oil levels in the housing
- making repairs as needed.

Process/Skill Questions

- Why is it important to check for fluid leaks on the housing?

Task Number 109

Check drive axle fluid level and condition.

Definition
Checking should include

- inspecting housing fluid levels per the manufacturer’s instructions
- inspecting condition of oil for metal or other possible contaminates adding lubricant as needed
- determining additional needed action.

Process/Skill Questions

- How would water enter an axle housing?
- What failure could metal shavings indicate?

Task Number 110

Replace differential carrier assembly.

Definition

Replacement should include

- utilizing proper tools for lifting the carrier following manufacturer’s instructions on the proper use of
  - gasket/sealant for carrier.

Process/Skill Questions

- What is the torque specification for carrier bolts?
- Where would you find those specifications?

Task Number 111

Replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings.

Definition

Replacement should include

- utilizing proper tools for lifting the carrier following manufacturer’s instructions on the proper use of
  - gasket/sealant for carrier.
Process/Skill Questions

- What is the torque specification for carrier bolts?
- Where would you find those specifications?

Task Number 112

Replace components of locking differential case assembly.

Definition

Replacement should include

- reference to OEM instructions on installing the locking differential case
- use of correct tools to install locking assembly.

Process/Skill Questions

- When do you install the differential lock assembly?

Task Number 113

Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore.

Definition

Inspection should include examining

- carrier housing for cracks, wear, leaks per the OEMs specifications
- bearings and cones for wear and discoloration.

Process/Skill Questions

- What does a “blued” bearing or cone indicate?
- What is one cause of a failed wheel seal?

Task Number 114

Measure ring gear runout.

Definition
Measurement should include

- reference to manufacturer's instructions on properly measuring backlash
- use of correct tools to take correct measurements
- set up of correct tooling to get accurate measurements.

Process/Skill Questions

- Should backlash be set to zero before beginning?
- After installing the carrier bearing caps and torqueing all bolts, should the backlash be rechecked? Why?

Task Number 115

Replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings.

Definition

Replacement should include

- inspection of ring and pinion gears, bearing and cones for wear according to manufacturer instructions
- use of proper tooling to lift and move parts.

Process/Skill Questions

- Should the ring and drive pinion gears be replaced in sets?
- What is the single most important item to know before replacing any drive components?
- How many steps are involved in diagnosing a failure?

Task Number 116

Adjust drive pinion bearing preload.

Definition

Adjustment should include

- reference to OEM guidelines for proper assembly
- use of correct lubricant when performing assembly.

Process/Skill Questions
• Should bearing be lubricated before adjusting preload?
• When do you read the torque value while adjusting preload?

Task Number 117

Adjust drive pinion depth.

Definition

Adjustment should include

• reference to manufacturer’s instructions in adjusting pinion depth
• assurance that you have sufficient shims for adjusting pinion position.

Process/Skill Questions

• What is the indication that the pinion needs to be adjusted?
• How many wear patterns could you see when inspecting the pinion gear that require depth adjustment?

Task Number 118

Adjust side bearing preload and ring gear backlash.

Definition

Adjustment should include

• reference to OEM instructions for improper backlash
• use of correct tooling to adjust bearing preload.

Process/Skill Questions

• Do the bearings and gears need to be lubed to adjust preload?

Task Number 119

Interpret ring gear and pinion tooth contact pattern.

Definition

Interpretation should include reference to OEM guidelines regarding wear patterns.
Process/Skill Questions

- What do you adjust to change backlash?
- What happens if you move the ring gear away from the pinion?

Task Number 120

Replace ring gear thrust block/screw.

Definition

Replacement should include

- reference to OEM to verify if the diff has thrust screw
- adherence to correct torque specs after installing.

Process/Skill Questions

- What is the required clearance of the thrust bolt?

Task Number 121

Inspect power divider (inter-axle differential) assembly.

Definition

Inspections should include the following:

- Oil leaks
- Air leaks
- Cracks
- Plugged breathers
- Movement in attached components

Process/Skill Questions

- What issue could a plugged breather cause?
- Movement in spring saddles can break what part of the axle housing causing what issue?

Task Number 122
Replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls.

Definition
Replacement should include use of manufacturer guidelines.

Process/Skill Questions
- What effect will air in a differential have on the axle?
- What would be the result in a bent airline coming from the inter-axle lock switch?

Task Number 123
Replace drive axle lubrication system.

Definition
Replacement should include reference to OEM guides for correct lubrication levels and types.

Process/Skill Questions
- How do you correctly fill a housing after repairing?
- What is the correct level for a housing when correctly filled?
- Can oil be reused when performing repairs on axle housings?

Task Number 124
Replace drive axle shafts.

Definition
Replacement should include
- evaluation of parts against manufacturers' reuse guidelines
- a visual inspection, performing proper torque to the axle flange nuts/bolts.

Process/Skill Questions
- What is a sign of a damaged axle shaft?
Task Number 125

Replace wheel assembly.

Definition

Replacement should include

- following the manufacturer's guidelines using proper lifting tools
- using proper installation tools
- determining proper torque specifications of wheel bearings
- checking rear wheel seal and axle flange gasket for leaks
- performing needed action.

Process/Skill Questions

- What is the proper torque method for your wheel bearing assembly?
- Do you prefill the hub before install? Why or why not?

Task Number 126

Identify causes of drive axle wheel bearing noise.

Definition

Identification should include

- performing inspection of oil for contamination
- determining proper bearing adjustment, using a dial indicator
- checking for damage performing needed action.

Process/Skill Questions

- What is the allowable end play for a wheel bearing?
- How do you determine you have a failing wheel bearing and race/cup?

Task Number 127

Inspect drive axle temperature gauge, wiring harnesses, and sending unit/sensor.

Definition
Inspection should include

- visually checking the wiring harness
- using a volt/ohm meter to verify proper operation
- determining needed action.

Process/Skill Questions

- Where is the drive axle temperature sensor located?
- How will a sending unit react with a short to ground?

Task Number 128

Replace wheel bearings, seals and wear rings, and retaining hardware.

Definition

Replacement should include

- following the manufacturer’s guidelines
- using proper lifting tools
- using proper installation tools
- determining proper torque specifications of wheel bearings.

Process/Skill Questions

- What is the proper torque method for your wheel bearing assembly?
- Do you prefill the hub before install? Why or why not?
- What tool should be used to install a wheel seal properly?

BRAKES

Brakes: Servicing Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC)

Task Number 129
Inspect ABS warning light operation.

Definition

Inspection should include using digital multimeter or a test light to indicate relevant components that may fail.

Process/Skill Questions

- What is the purpose of the ABS brake warning light?
- How is an ABS brake warning light tested?
- What will activate the ABS brake warning light?

Task Number 130

Diagnose ABS electronic control(s) and components.

Definition

Diagnosis should include

- confirming that the vehicle performs the ABS self-test before beginning the test drive
- confirming that the brake pedal has the proper amount of resistance when pressed.

Process/Skill Questions

- What would cause a spongy, weak, or no-brake pedal?
- What might cause a very hard brake pedal with very little effort applied to the brakes?
- What do the brakes feel like when the ABS system engages?

Task Number 131

Identify poor stopping and wheel lock-up problems caused by failure of the ABS.

Definition

Identification should include putting the vehicle through a variety of braking scenarios during the test drive to check for even and smooth braking confirming that there is no engagement of the ABS system under normal braking conditions.

Process/Skill Questions
• If the ABS system is inoperable, how will the vehicle stop?

**Task Number 132**

**Test operation of ABS air, hydraulic, electrical, and mechanical components.**

**Definition**

Testing should include

- inspecting the warning light for proper operation
- visually inspecting the wires, hydraulic lines, and mechanical components for damage and leaks.

**Process/Skill Questions**

- Does the warning light operate as per the manufacturer specifications?
- What might cause brakes to lock up during operation?

**Task Number 133**

**Test ABS wheel speed sensors and circuits.**

**Definition**

Testing should include determining the braking components involved and their proper operation.

**Process/Skill Questions**

- What are the components of ABS system?
- How does the wheel-speed sensor operate?

**Task Number 134**

**Bleed the ABS hydraulic circuits.**

**Definition**

Bleeding procedures should include

- following manufacturer procedure for proper bleeding
• using the proper brake fluid, as recommended by the manufacturer.

Process/Skill Questions

• How will the brake pedal operate if the brakes need bleeding?
• What might happen if the proper bleeding procedure is not followed?

Task Number 135

Observe ATC warning light operation.

Definition

Observation should include determining the braking components involved and their proper operation.

Process/Skill Questions

• What are the components of ATC systems?
• What are the types of ATC systems?
• How does the wheel-speed sensor operate?

Task Number 136

Diagnose ATC electronic control(s) and components.

Definition

Diagnosis should include determining the braking components involved and their proper operation.

Process/Skill Questions

• How does the wheel-speed sensor operate?

Task Number 137

Verify power line carrier (PLC) operations.

Definition
Verification should include using of a digital multimeter following manufacturer's recommended testing procedures.

Process/Skill Questions

- What type of test equipment is necessary to verify proper operation of the PLC?

SUSPENSION AND STEERING

Suspension and Steering: Steering Column

Task Number 138

Install and center the steering wheel.

Definition

Installation should include

- deactivating supplemental restraint system (SRS)
- using a steering wheel puller
- following manufacturer's guidelines.

Process/Skill Questions

- What is the function of the clock spring?
- What precautions should be taken when working with the clock spring?
- Where would the technician find procedures for centering the clock spring?
- What procedure should be followed when removing a steering wheel?

Task Number 139

Enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.

Definition

Enabling should include

- disconnecting battery and waiting 30 minutes before proceeding
- following manufacturer's guidelines.
Process/Skill Questions

- Why is it important to follow manufacturer guidelines when disabling an SRS?
- What could happen if the air bag deploys at the wrong time?
- What precautions should be taken when handling removed airbags?

Suspension and Steering: Frame and Coupling Devices

Task Number 140

Service fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware.

Definition

Servicing should include inspecting and making necessary adjustments. Fifth wheel jaws periodically need adjusting to take the slack out between the pin and fifth wheel. The fifth wheel needs to be kept lubricated so the trailer will not bind metal against metal, which could impair turning and push the tractor in a straight line.

Process/Skill Questions

- How often should the fifth wheel connection be checked?
- Can the mounting bolts be checked with a hammer to determine if the bolts connecting the fifth wheel plate to the tractor frame? Explain.

Task Number 141

Service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.

Definition

Servicing should include

- checking the air line to make sure that it is not damaged.
- checking the locking system's connection to the air cylinders and the springs
- greasing the tracks, locking pins, and holes.

Process/Skill Questions
• Why is the fifth wheel a major part of a vehicle's preventive maintenance check?
• What should you do if you find any damage on the fifth wheel or mounting plate?
• Why should you keep the fifth wheel greased?

**Task Number 142**

**Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage.**

**Definition**

Inspection should include a visual check of the frame from the outside and inside for breaks, twists, loose bolts, and slotted holes. While under the vehicle doing the inspection, make sure to check the cross members.

**Process/Skill Questions**

- Should broken cross members be repaired or replaced? Explain.
- Should a cracked frame be welded? Explain.
- What could cause a twisted frame?

**Task Number 143**

**Inspect frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures.**

**Definition**

Inspection should include a visual check of the frame from the outside and inside for breaks, twists, loose bolts, and slotted holes. While under the vehicle doing the inspection, make sure to check the cross members. Damaged components should be evaluated for replacement.

**Process/Skill Questions**

- Why do many components just need repairing while others need replacing?

**Task Number 144**
Inspect pintle hooks and draw bars, if applicable.

Definition

Pintle hooks and draws bars deal with excessive stress and should always be closely examined for structural damage. Make sure that all bolts and connecting hardware has no damage. Pintle hooks should have a chain connected with a locking pin. Visually inspect the frame where the pintle hook connects. Any damage should result in the vehicle being deadlined (red tagged).

Process/Skill Questions

- What is it so important for the latch to operate properly on a pintle hook?
- Should the chains attach to the pintle hook or to the trailer? Explain.

ELECTRICAL/ELECTRONIC SYSTEMS

Electrical/Electronic Systems: Servicing Gauges and Warning Devices

Task Number 145

Verify instrument cluster operations using recommended electronic service tool(s).

Definition

Verification should include

- determining and interpreting diagnostic trouble codes (DTC)
- following symptom-based troubleshooting
- referring to services materials and manufacturer guidelines.

Process/Skill Questions

- What advantages do factory scan tools have over after-market tools?
- What steps must be taken after receiving an error message?
- Why did manufacturers begin to implement controller area network (CAN or CAN bus) systems?

Task Number 146
Identify causes of data bus-driven gauge malfunctions.

Definition

Procedure should include

• determining and interpreting DTCs
• following symptom-based troubleshooting
• referring to services materials and manufacturer guidelines.

Process/Skill Questions

• What steps must be taken after receiving an error message?
• Why did manufacturers begin to implement CAN/BUS systems?

Electrical/Electronic Systems: Servicing Related Electrical Systems

Task Number 147

Perform diagnostic procedures using recommended electronic service tool(s).

Definition

Procedure should include

• determining the connector location
• entering the correct vehicle data
• using the scan tool to acquire diagnostic trouble codes (DTC), on-board diagnostics (OBD) monitor status, freeze frame data, and clear DTCs, when applicable.

Process/Skill Questions

• What does the DTC's prefix indicate about the system?
• Which systems on the vehicle can be accessed with the scan tool?

Task Number 148

Check operation of keyless and remote lock/unlock devices.
Definition

Checking should include

- defining the operation of the keyless-entry system
- defining the operation of the remote-start system
- listing the locations of system components.

Process/Skill Questions

- Why should remote-start not be used with manual transmissions?
- What would cause poor range of a keyless-entry system?
- What could cause an inoperative keyless-entry system?
- What would cause a lack of effective range for keyless entry?
- How do you program remote keyless entry?

Task Number 149

Identify causes of data bus communication problems.

Definition

Procedure should include

- determining and interpreting DTCs
- following symptom-based troubleshooting
- referring to services materials and manufacturer guidelines.

Process/Skill Questions

- What steps must be taken after receiving an error message?
- Why did manufacturers begin to implement CAN/BUS systems?

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

Heating, Ventilation, and Air Conditioning: Servicing HVAC Systems

Task Number 150
Verify the need for service or repair of HVAC systems based on unusual operating noises.

Definition

Verification should include

- testing for proper operation of each component within the system
- determining needed action.

Process/Skill Questions

- How does the expansion valve work?
- What is the proper refrigerant charge and type?

Task Number 151

Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions.

Definition

Verification should include

- visually inspecting interior for moisture on floor board
- determining needed action.

Process/Skill Questions

- Where will you see/feel icing if there is a restriction in the liquid line?

Task Number 152

Conduct performance test(s) on HVAC systems.

Definition

Conducting should include

- identifying system type and components (cycling clutch orifice tube [CCOT], expansion valve)
- following manufacturer's detailed steps for conducting an HVAC performance test
• determining needed action.

Process/Skill Questions

• How long should a vehicle sit before you perform a static reading test? Explain.
• Which doors and/or windows should be open during the performance test? Explain.

Task Number 153

Retrieve diagnostic codes.

Definition

Retrieval should include

• using electronic service tool retrieve codes
• determining needed action.

Process/Skill Questions

• Where would you find troubleshooting steps for retrieved codes?

Heating, Ventilation, and Air Conditioning (A/C): Servicing Air Conditioning (A/C) System and Components, General

Task Number 154

Identify causes of temperature control problems in the A/C system.

Definition

Identification should include

• using thermometers to take temperature readings at specified location during performance test
• determining needed action.

Process/Skill Questions
• What are the causes of low vent temperatures?

**Task Number 155**

**Check for contamination of refrigerant and lubricant.**

**Definition**

Checking should include

• using electronic tools and visual inspection
• verifying possible contamination to the HVAC system
• determining needed action.

**Process/Skill Questions**

• What failure does metal in the oil indicate?
• What dangerous contaminates can be found in refrigerant?

**Task Number 156**

**Identify A/C system problems indicated by pressure gauge and temperature readings.**

**Definition**

Identification should include

• performing a static reading test and comparing to specifications
• performing an A/C performance test per the manufacturer's instruction
• determining needed action.

**Process/Skill Questions**

• What is the deficiency in the system if your static pressures are 10 pounds per square inch (psi) higher than your chart values?
• Does your system have to be at ambient temperature to perform the static test? Explain.

**Task Number 157**

**Identify A/C system problems indicated by visual, audible, smell, and touch procedures.**
Definition

Inspection should include

- checking for visible dye
- inspecting for oil leaks at fitting connections or compressor
- icing of lines near drier
- determining needed action.

Process/Skill Questions

- What tool should be used to check for refrigerant leaks?

Task Number 158

Perform A/C system leak test.

Definition

Performance should include

- following the manufacturer’s troubleshooting guide
- using proper tools to perform test
- determining needed action.

Process/Skill Questions

- How long should you allow the system to remain a vacuum to verify leaks? Explain.

Task Number 159

Recharge A/C system using appropriate equipment.

Definition

Recharging should include

- using proper tools to handle refrigerant recovery and recycling
- determining amount of refrigerant oil to add back into the system before recharge
- using proper refrigerant type based on the system you are working on.

Process/Skill Questions
• How do you determine the amount of refrigerant to recharge the system?
• What is the process to identify how much oil need to be added back into the system?
• What type of oil is to be used?

Task Number 160

Identify contamination in the A/C system components.

Definition

Identification should include

• visually inspecting the oil during removal
• using proper tools for refrigerant identification
• determining needed action.

Process/Skill Questions

• Where should the refrigerant identifier be connected to test a sample?

Task Number 161

Perform diagnostic procedures using recommended electronic service tool(s).

Definition

Performance should include

• interfacing with the vehicle's on-board computer
• using PC-based software and/or data scan tools
• using appropriate gauges or HVAC service tooling
• determining needed action.

Process/Skill Questions

• What type of certification do you need to perform automotive HVAC system repairs?

Heating, Ventilation, and Air Conditioning: Servicing Compressor and Clutch
Task Number 162

Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation.

Definition

Identification should include

- using all required tooling
- determining failure
- determining needed action.

Process/Skill Questions

- What will cause a high-pressure switch to engage?

Task Number 163

Replace A/C system pressure, thermal, and electronic devices.

Definition

Replacement should include

- inspecting system and devices
- testing system and devices
- using proper tools.

Process/Skill Questions

- What tool is used to remove refrigerant from the HVAC system?

Task Number 164

Replace A/C compressor drive belts, pulleys, and tensioners.

Definition
Replacement should include

- determining belt condition
- following manufacturer’s guidelines
- using proper tooling to remove pulleys and tensioners
- adjusting belt tension
- checking alignment.

Process/Skill Questions

- What are the acceptable number of cracks per inch in a multi-groove belt?
- What sound are you listening for when determining pulley or tensioner failure?

Task Number 165

Service A/C compressor clutch components or assembly.

Definition

Servicing should include

- inspecting components
- adjusting components
- following troubleshooting and repair guidelines set by the manufacturer.

Process/Skill Questions

- What should be done prior to removing lines from the compressor?
- What safety equipment should always be used when working on any high-pressure system?

Task Number 166

Correct A/C compressor lubricant level (if applicable).

Definition

Correction should include

- inspecting the lubricant level
- determining the amount of oil removed during the recovery process.

Process/Skill Questions
• How is the oil added into the system before it is closed?
• How do you add oil into a closed system?

Task Number 167

Replace A/C compressor.

Definition

Replacement should include

• verifying the failure
• identifying and removing refrigerant and oil
• using proper tooling to recover and recycle refrigerant
• replacing the drier/receiver.

Process/Skill Questions

• When should the drier/receiver be replaced?
• When oil is added to the new compressor, what should be done with the compressor?

Task Number 168

Replace A/C compressor mountings and hardware.

Definition

Replacement should include

• visually inspecting hardware for wear and condition
• determining whether to repair or replace.

Process/Skill Questions

• When should the compressor O-rings be replaced?

Heating, Ventilation, and Air Conditioning: Servicing Evaporator, Condenser, and Related Components
Task Number 169

Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses.

Definition

Determine the amount of oil removed during the recovery process.

Process/Skill Questions

- How is the oil added into the system before it is closed?
- How do you add oil into a closed system?

Task Number 170

Inspect A/C system hoses, lines, filters, fittings, and seals.

Definition

Visually inspect for dye in hardware parts oil accumulating on hoses and seals.

Process/Skill Questions

- How can you determine the location of a leak without a leak detecting device?

Task Number 171

Test A/C system condenser.

Definition

Visually inspect for leaks looking for oil accumulation, using proper tooling pull system into vacuum.

Process/Skill Questions

- What are the causes for low refrigeration?
- What are telling signs of a possible system leak?
Task Number 172

Replace receiver/drier or accumulator/drier.

Definition

Remove receiver drier per instructions.

Process/Skill Questions

- When should a receiver/drier or accumulator/drier be replaced?
- When should you open a receiver drier to inspect for metal contamination?

Task Number 173

Test cab/sleeper refrigerant solenoid, expansion valve(s), and thermal bulb (capillary tube).

Definition

Utilize manufacturer's performance A/C test to determine proper operation.

Process/Skill Questions

- What is the cause of a frozen expansion valve?

Task Number 174

Replace orifice tube.

Definition

Utilize proper tooling to evacuate the system of all refrigerant. Locate, remove, and inspect the orifice tube for damage, and plugging.

Process/Skill Questions

- What system failure will be the cause of a plugged orifice tube?

Task Number 175
Test cab/sleeper evaporator core.

Definition
Test should include an inspection for leaks freeing.

Process/Skill Questions
- What would a frozen evaporator core indicate?
- What effect does this have to the overall cooling of the system?

Task Number 176

Repair evaporator housing and water drain.

Definition
Visually inspect for leaks within the cab or sleeper. Determine cause of the water drain blockage.

Process/Skill Questions
- What does no water from the drain possibly indicate?
- What will excessive dirt on the evaporator cause?

Task Number 177

Inspect A/C system service ports (gauge connections).

Definition
Utilizing proper tooling, inspect ports for dye or leaks. Installing gauges, check fit of ports onto gauges.

Process/Skill Questions
- What is the cause of dye or oil pooling on a service port?
- Why are the ports identified with red and blue caps?

Task Number 178
Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device.

Definition

Identification should include the following possible causes:

- Plugging moisture in the system
- Fan not operational
- Restricted air flow

Process/Skill Questions

- Why would a non-operational cooling fan cause the valve to release?

Heating, Ventilation, and Air Conditioning: Servicing Heating and Engine Cooling Systems

Task Number 179

Identify causes of outlet air temperature control problems in the HVAC system.

Definition

Identification should include performing an A/C system test to determine causes of air temp control in the HVAC system.

Process/Skill Questions

- What should the vent temperature and ambient air temperature readings be to show proper operation?

Task Number 180

Identify window fogging problems.

Definition
Possible causes include moisture inside of the vehicle, not draining humidity mode doors not correctly setting in place.

**Process/Skill Questions**

- What should happen within the HVAC system when the defrost is turned on?

**Task Number 181**

**Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration.**

**Definition**

Inspection should include

- pressure testing of the cooling system
- using the proper tool for checking protection levels, (refractometer)
- coolant conditioner checks with coolant test strips

**Process/Skill Questions**

- Where will you find the correct pressure to test the cooling system on a vehicle?
- When do you pressure test the coolant cap?
- What effect does the conditioner have on the cooling system?

**Task Number 182**

**Inspect engine cooling and heating system hoses, lines, and clamps.**

**Definition**

Inspection should include

- visual inspection of the system
- pressure testing of the system to identify leaks.

**Process/Skill Questions**

- Where will you find the correct pressure to test the cooling system on a vehicle?
• When do you pressure test the coolant cap?

**Task Number 183**

**Inspect and test radiator, pressure cap, and coolant recovery system (surge tank).**

**Definition**

Inspection should include visual inspection of the system pressure testing of the system to identify leaks.

**Process/Skill Questions**

• Where will you find the correct pressure to test the cooling system on a vehicle?
• When do you pressure test the coolant cap?
• What is the purpose of the surge tank?

**Task Number 184**

**Inspect water pump.**

**Definition**

Inspection should include

• pressure testing of the coolant system
• coolant conditioning protection levels
• visual inspection of the water pump itself.

**Process/Skill Questions**

• What is the difference between a weep and a leak on a water pump?
• What will occur if the water pump fails to move water through the system?

**Task Number 185**

**Inspect and test thermostats, by-passes, housings, and seals.**

**Definition**
Utilize manufacturer's troubleshooting and repair manual for proper test procedures of the cooling system.

**Process/Skill Questions**

- What will a stuck closed thermostat do to the cooling system?
- How will a leak within the cooling system affect performance?

**Task Number 186**

**Refill with recommended coolant/additive package.**

**Definition**

Refer to manufacturer's recommendations for coolant type.

**Process/Skill Questions**

- What is the difference between green coolant and purple coolant?
- What is the possible effect of using the wrong type of coolant?

**Task Number 187**

**Inspect thermostatic cooling fan system (i.e., hydraulic, pneumatic, and electronic) and fan shroud.**

**Definition**

Inspection should include

- verification of fan clutch type
- verification of proper operation of the fan clutch
- visual inspection of the fan shroud for broken or missing pieces.

**Process/Skill Questions**

- What occurs when a viscous style fan clutch fails to engage?
- What effect does the fan have on the cooling system?

**Task Number 188**
Test heating system coolant control valve(s) and manual shut-off valves.

Definition

Testing should include

- complete operation of manual shut off valves
- verification that coolant control valves are operating by taking temperature reading.

Process/Skill Questions

- What is the purpose of the coolant control valve?
- What is the purpose of installing a manual shut off valve in the cooling system?

Task Number 189

Inspect heater core.

Definition

Inspection should include

- visual inspection of the core for coolant leaks
- pressure testing of the cooling system for leaks
- visual inspect of plugging of the face of the heater core.

Process/Skill Questions

- What failure would a plugged heater core cause to the HVAC system?
- How are most heater core leaks identified?

Heating, Ventilation, and Air Conditioning: Servicing Electrical Operating Systems and Related Controls

Task Number 190

Identify causes of HVAC electrical control system problems.
Definition

Identification includes the following causes:

- Compressor clutch not engaging
- Pressure switches not allowing system to function correctly

Process/Skill Questions

- What problems will shorts cause to the system?

Task Number 191

Test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices.

Definition

Test should include manufacturer's performance A/C test to ensure system is working as designed.

Process/Skill Questions

- What is the problem when a blower will only work on one or two speeds?
- What occurs when the blend air door stays closed?

Task Number 192

Test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices.

Definition

Test should include manufacturer's performance A/C test to ensure system is working as designed.

Process/Skill Questions

- What occurs when the low pressure switch activates?
- How do the low and high pressure switches protect the system?

Task Number 193
Test A/C related electronic engine control systems.

Definition

Test should include manufacturer's performance A/C test to ensure system is working as designed.

Task Number 194

Test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices.

Definition

Test should include

- using OEM wiring diagrams and manuals to perform proper troubleshooting steps
- using proper tooling follow troubleshooting steps
- use manufacturer software to perform system operational tests.

Process/Skill Questions

- How do you determine an open switch vs. a closed switch?
- What setting on a multimeter do you use to check ohms?

Task Number 195

Test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices.

Definition

Test should include use of

- OEM wiring diagrams and manuals perform proper troubleshooting steps
- proper tooling follow troubleshooting steps
- manufacturer software to perform system operational tests.

Process/Skill Questions
• How do you determine an open switch vs. a closed switch?
• What setting on a multimeter do you use to check ohms?
• How do you perform a voltage drop test to a wire?

**Task Number 196**

**Test HVAC system electrical/electronic control panel assemblies.**

**Definition**

Test should include

• inspection of controls
• determination of binding or sticking.

**Process/Skill Questions**

• What occurs when there is a short with the control head on the mode function knob?

**Task Number 197**

**Perform diagnostic procedures using recommended electronic service tool(s).**

**Definition**

Performance should include using electronic service tool retrieve codes.

**Process/Skill Questions**

• Where would you find troubleshooting steps for retrieved codes?

**Heating, Ventilation, and Air Conditioning: Servicing Air/Mechanical Operating Systems and Related Controls**

**Task Number 198**
Identify causes of HVAC air and mechanical control problems.

Definition

Identification should include

- visually inspecting system for leaks
- operating controls to ensure proper operation.

Process/Skill Questions

- What would a failed sleeper coolant control valve cause to the cooling system?

Task Number 199

Test HVAC system air and mechanical control panel assemblies.

Definition

Test should include

- visually inspecting the condition of the panel
- manually working control panel to ensure electrical and cable driven control work properly.

Process/Skill Questions

- What would be the cause of a stuck mode position control?
- How would a broken temp control knob affect A/C performance?

Task Number 200

Adjust HVAC system air and mechanical control cables and linkages.

Definition

Adjustment should include

- inspection of linkages and controls
determination of binding or sticking.

Process/Skill Questions

- What occurs if the temperature knob does not move within the hot and cold range fully?
- What will be the result of a controller that is stuck in defrost mode?

Task Number 201

Test HVAC system actuators and hoses.

Definition

Test should include using the manufacturer's performance A/C test to determine proper operation.

Process/Skill Questions

- What is the optimal vent temperature based on 95 degrees ambient air temperature?

Task Number 202

Adjust HVAC system ducts, doors, and outlets.

Definition

Adjustment should include following manufacturer's guidelines for Performance A/C test ensure all doors and vents are working as designed.

Process/Skill Questions

- What will a stuck defrost door cause in the operation of the system?
- How will a vacuum leak impact the door positions?

Heating, Ventilation, and Air Conditioning: Handling Refrigerant

Task Number 203

Verify correct operation of certified equipment.
Definition

Verification should include following manufacturer's guidelines and instruction to ensure the proper operation of the equipment.

Process/Skill Questions

• What are the signs of a failed recovery tool?

Task Number 204

Recover A/C system refrigerant.

Definition

Recovery should include

• determining refrigerant condition
• removing contaminated refrigerant into a different cylinder than the one you are using for recycling
• utilizing the proper tooling to remove the refrigerant from the system.

Process/Skill Questions

• Can you vent any type of refrigerant to the atmosphere?
• Can recovered clean refrigerant be reused?

Task Number 205

Recycle or properly dispose of refrigerant.

Definition

Determine refrigerant condition. Remove contaminated refrigerant into a different cylinder than the one you are using for recycling.

Process/Skill Questions

• Can you vent any type of refrigerant to the atmosphere?
• When can recovered clean refrigerant be reused?

Task Number 206
Store refrigerant.

Definition

Storage should include

- following Environmental Protection Agency (EPA) guidelines to ensure refrigerant container is inspected and approved before use
- identifying a location that cylinders can be stored upright and void of combustible materials.

Process/Skill Questions

- What is the maximum temperature refrigerant should be stored?
- Which recovery process is slower: vapor or liquid recovery?

Task Number 207

Test recycled refrigerant for non-condensable gases.

Definition

Testing should include the use of proper tool for refrigerant identification.

Process/Skill Questions

- Where should the refrigerant identifier be connected to test a sample?

PREVENTIVE MAINTENANCE AND INSPECTION

Preventive Maintenance and Inspection: Servicing Cab and Hood Instruments and Controls

Task Number 208
Check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems).

Definition

Procedure should include

- determining the connector location
- entering the correct vehicle data
- using the scan tool
- acquiring DTCs, OBD monitor status, freeze frame data, and clear DTCs, when applicable.

Process/Skill Questions

- What does the DTC prefix indicate about the system?
- List the systems on the vehicle that can be accessed with the scan tool?

HYDRAULICS

Hydraulics: Servicing General System

Task Number 209

Identify system type (closed and open) and proper operation.

Definition

Identification should include reviewing manufacturer literature or hydraulic schematic to determine type of hydraulic system.

Process/Skill Questions

- What is the difference between an open-looped and a closed-loop hydraulic system?
- What are the pros and cons of each system?

Task Number 210

Interpret system diagrams and schematics.

Definition
Interpretation should include

- tracing the oil flow on the hydraulic schematics
- identifying components with their International Organization for Standardization (ISO) symbols
- demonstrating basic troubleshooting skills with the use of schematics.

Process/Skill Questions

- Why are ISO symbols used on schematics?

Task Number 211

Perform system temperature, pressure, flow, and cycle time tests.

Definition

Performance should include

- following manufacturer instructions for conducting the thorough testing of the hydraulic system
- utilizing all required tooling
- determining needed action.

Process/Skill Questions

- If cycle times are reported slow, what would be the first component that you would test?
- What problems can high hydraulic oil temperature cause?
- Would increasing the hydraulic pressure in a system cause the oil flow to increase? Explain.

Task Number 212

Verify placement of equipment/component safety labels and placards.

Definition

Verification should include

- obtaining a copy of the manufacturer’s safety guidelines
- matching manufacturer’s safety requirements instead of what is displayed on the machine
determining needed action.

Process/Skill Questions

- What is the subject matter of the various safety decals placed on the equipment?
- Why are universal safety decals used whenever possible?

Hydraulics: Servicing Pumps

Task Number 213

Identify system fluid type.

Definition

Identification should include following manufacturer specifications for the proper hydraulic oil.

Process/Skill Questions

- Where would you find the manufacturer’s hydraulic oil specification?

Task Number 214

Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems.

Definition

Identification should include

- following the manufacturer's troubleshooting guide for the hydraulic system
- utilizing all required tooling and parts
- determining needed action.

Possible causes include

- low oil level
- wrong oil
- aeration and cavitation of the pump
- faulty or dirty cooler
- worn cylinder seals
- damaged cylinders.
Process/Skill Questions

- What are the causes for aeration and cavitation of the hydraulic pump?
- What procedures need to be performed if a hydraulic pump fails and sends metal through the hydraulic system?
- What are the signs of an overheated hydraulic pump?

Task Number 215

Determine pump type, rotation, and drive system.

Definition

Determination should include

- locating the manufacturer's specifications for the hydraulic pump which will note type of pump and direction of rotation
- reviewing the service literature to determine drive system (mechanical, electric, hydraulic).

Process/Skill Questions

- What are the three major types of hydraulic pumps?
- What are the advantages and disadvantages of each style of pump?
- Can the rotation of a pump be changed? Explain.

Task Number 216

Install pump.

Definition

Installation should include

- removing old pump per service instructions
- determining reusability or cause of failure
- flushing hydraulic system if necessary
- installing new pump and mounting seals
- filling pump with proper oil reconnecting pressure line
- cycling hydraulics slowly to purge air from the system.

Process/Skill Questions

- Why does a hydraulic pump need to be primed?
• Why is a pump's suction line usually made in two pieces connected by a rubber sleeve?

**Task Number 217**

**Inspect pump inlet for restrictions and leaks.**

**Definition**

Inspection should include

• performing a visual inspection of the pump's suction side
• searching the suction line and rubber sleeve for debris, damage, or deterioration
• double-clamping the rubber sleeve on the suction line
• determining needed action.

**Process/Skill Questions**

• Why is the suction line usually made in two pieces connected with a rubber sleeve?
• What is the term used when a pump is starving for oil?

**Task Number 218**

**Inspect pump outlet for restrictions and leaks.**

**Definition**

Inspection should include

• performing a visual inspection of the pump's pressure side
• replacing O-ring seal on pressure line
• determining needed action.

**Process/Skill Questions**

• Which port on the hydraulic pump is larger, the suction port or the outlet port?
• Should the O-ring be lubricated before installation? If so with what?

**Hydraulics: Servicing Filtration/Reservoirs (Tanks)**
Task Number 219

Identify type of filtration system and flow direction.

Definition

Identification should include

- determining whether the main oil filter is located on the pressure side of the pump or the return side
- checking for type of filter used
- verifying application of the filter
- determining flow direction.

Process/Skill Questions

- Why do some hydraulic systems have both a paper filter and a metal screen in a separate filter base?
- When should a hydraulic oil filter be changed?
- Why are some oil filters placed on the pressure side of the pump while others are placed in the hydraulic tank on the return side?

Task Number 220

Service filters and breathers.

Definition

Service should include

- changing filter(s) according to manufacturers' recommendations
- cutting filter open and examining for debris
- cleaning breather in non-flammable solvent.

Process/Skill Questions

- What are the pros and cons of a spin-on oil filter and a cartridge style filter?
- Why are some hydraulic tanks vented while most are pressurized?

Task Number 221

Identify causes of system contamination.
Definition

Identification should include

- determining the contaminant: dirt, water, antifreeze, metal (steel, aluminum, brass), rubber
- based upon the contaminant, analyzing the source of possible entry
- determining needed action.

Process/Skill Questions

- How does identifying the contaminant help determine the source of the problem?
- Why is flushing a system important after a failure in the hydraulic system?

Task Number 222

Take a hydraulic oil sample for analysis.

Definition

Follow laboratory instructions for the proper extraction of a hydraulic oil sample.

Process/Skill Questions

- What type of wear metals might be found in a hydraulic oil sample?
- If antifreeze is noted in the sample report, what component might be the source of the contaminant?

Task Number 223

Check reservoir fluid level and condition.

Definition

Check should include

- positioning vehicle on a level surface
- retracting all hydraulic cylinders
- checking the system cold, if possible
- ensuring oil level is within the operating range in the sight glass
- determining needed action.

Process/Skill Questions
• What problems could overfilling a hydraulic system cause?
• What could cause the oil to look foamy or aerated in the sight glass?

Task Number 224

Repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines.

Definition

Repairing or replacing should include

• performing a visual inspection of the hydraulic tank and all related components for damage, wear, leaks or interference issues
• determining needed action.

Process/Skill Questions

• Why should you never open the hydraulic tank cap while the oil is hot?

Hydraulics: Servicing Hoses, Fittings, and Connections

Task Number 225

Diagnose causes of component leakage, damage, and restriction.

Definition

Diagnosis should include

• inspecting hoses and fittings for damage and leakage
• tightening bolts replacing O-rings and hoses as needed
• determining additional needed action.

Process/Skill Questions

• Why is important to look for sources of hydraulic leaks as part of a daily walk-around inspection?
Task Number 226

Inspect hoses and connections (length, size, routing, bend radii, and protection).

Definition

Inspection should include

- determining whether hydraulic hoses are the correct length and are routed and secured according to manufacturers' specifications
- determining needed action.

Process/Skill Questions

- What is the major cause for hydraulic hose failures?

Task Number 227

Assemble hoses, tubes, connections and fittings in accordance with manufacturer’s specifications.

Definition

Assembly should include

- following all necessary contamination control requirements
- attaching protected covers at each end of hoses to prevent contamination and damage to the seals.

Process/Skill Questions

- What is the #1 cause of hydraulic system failure?
- How is the inside of a hydraulic hose cleaned after being cut to length?

Task Number 228

Inspect fitting seals and sealants.

Definition

Inspection should include
- looking for signs of leakage or damage surrounding hydraulic fittings
- replacing fitting seals and sealants as necessary
- ensuring the seals and sealants are compatible with the fluids and temperatures of the hydraulic system.

Process/Skill Questions

- Why are there many different colors of O-rings used in a hydraulic system?
- What is the difference between an aerobic and anaerobic sealant?

Hydraulics: Servicing Control Valves

Task Number 229

Pressure test system safety relief valve.

Definition

Testing should include following manufacturers' procedure for checking the maximum relief pressure setting of the system.

Process/Skill Questions

- How do you determine what range gauge is used when checking maximum system pressure?

Task Number 230

Perform control valve operating pressure and flow tests.

Definition

Performance should include following manufacturers' procedure to safely check the operation of the control valves.

Process/Skill Questions

- What might be the operator's main complaint if the control valves are not functioning properly?

Task Number 231
Test valve controls (i.e., electrical/electronic, mechanical, pneumatic).

Definition

Test should include

- performing a visual, operational, and diagnostic test of the hydraulic valves per manufacturers' specification
- making adjustments as needed.

Process/Skill Questions

- What are the pros and cons of having an electrical, mechanical, or pneumatic activated control valve?
- What diagnostic tools would be used in troubleshooting each different system?

Task Number 232

Identify causes of control valve leakage (internal/external).

Definition

Identification should include

- performing a visual inspection for any external control valve leaks
- performing an operational test of the control valves to identify internal valve leakage problems
- repairing or replacing as necessary.

Process/Skill Questions

- What is the major cause of internal control valve leakage?

Task Number 233

Inspect pilot control valve linkages, cables, and power take-off (PTO) controls.

Definition

Inspection should include
• performing both a visual and operational check of the pilot lines, linkage, and cables that operate the hydraulic control valves
• looking for binding, rust, and leakage of the actuating members
• adjusting, repairing, or replacing as needed.

Process/Skill Questions

• Why have many hydraulic control systems removed linkages and cables and replaced them with electrical/electronic mechanisms?

Hydraulics: Servicing Actuators

Task Number 234

Identify actuator type.

Definition

Identification should include visual and operational checks to verify the style of each actuator, including

• single/double acting
• multi-stage/telescopic
• motors.

Process/Skill Questions

• What is the use of each different type of actuator?
• How does each operate?

Task Number 235

Identify the cause of seal failure.

Definition

Identification should include

• performing visual checks and operational tests to verify the operation of each actuator
• taking an oil sample
• disassembling actuator to access seals and determine cause of failure
• repairing as necessary.
Process/Skill Questions

- What is the #1 cause of hydraulic seal failure?
- What procedures need to be followed when making a seal repair?

Task Number 236

Identify the cause of incorrect actuator movement and leakage (internal and external).

Definition

Identification should include

- performing both a visual check and operational test to isolate actuator leakage problems
- determining needed action.

Process/Skill Questions

- What would cause an actuator to move down when the control lever is in the Hold position?
- What is the major cause for internal seal wear?

Task Number 237

Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage.

Definition

Inspection should include

- performing a visual inspection and operational check to isolate any mounting problems or damage to the actuator
- determining needed action.

Process/Skill Questions

- Other than damage to itself, what other kinds of problems can a loose actuator have on the vehicle?
Task Number 238

Repair and/or replace actuators in accordance with manufacturers' recommended procedures.

Definition

Repairing or replacing should include

- following all safety guidelines
- utilizing special tools for the removal and disassembly of the actuator
- evaluating all parts against manufacturers' reuse guidelines.

Process/Skill Questions

- What is a sign of a bent actuator rod?
- What factors must be considered when making a decision to rebuild or replace the actuator?

Task Number 239

Inspect actuators for dents, cracks, damage, and leakage.

Definition

Inspection should include

- disassembling the actuator
- performing a visual inspection
- determining cause of failure
- determining which parts can be reused
- determining needed action.

Process/Skill Questions

- What problems can a dent in the barrel of the actuator cause?

Task Number 240

Purge and/or bleed system in accordance with manufacturers' recommended procedures.
Definition

Task should include

- reassembling the components
- adding sufficient oil to the system
- follow manufacturers' recommendation for the purging of air from the hydraulic system.

Process/Skill Questions

- What problems can air in the hydraulic system cause?

SOL Correlation by Task

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<tr>
<td>procedures for using fire extinguishers and other fire safety equipment.</td>
<td>History and Social Science: GOVT.9, GOVT.15, GOVT.16.</td>
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<td>Identify the location of the posted evacuation routes.</td>
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<td>Comply with the required use of safety glasses, ear protection, gloves,</td>
<td>English: 12.5</td>
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<td>and shoes during lab/shop activities.</td>
<td>History and Social Science: GOVT.9, GOVT.15, GOVT.16</td>
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<td>Identify and wear appropriate clothing for lab/shop activities.</td>
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<td>Secure hair and jewelry for lab/shop activities.</td>
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<td>systems (SRS), electronic brake control systems, and hybrid vehicle high</td>
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<td>voltage circuits.</td>
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<td>Demonstrate awareness of the safety aspects of high voltage circuits</td>
<td>English: 12.5</td>
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<td>(such as high intensity discharge [HID] lamps, ignition systems, injection</td>
<td>History and Social Science: GOVT.9</td>
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<td>systems, etc.).</td>
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<tr>
<td>Demonstrate knowledge of safety data sheets' (SDS) location and content.</td>
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<td></td>
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<td>Inspect exhaust after treatment devices.</td>
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<td>Inspect fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, engine control module (ECM) cooling plates, and mounting hardware.</td>
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<td>Inspect pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings).</td>
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<td>Inspect power and ground circuits and connections.</td>
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<td>Interface with vehicle’s on-board computer.</td>
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<td>Record electronic diagnostic codes and trip/operational data.</td>
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<td>Use relevant service information.</td>
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<td>Replace electrical connector terminals, seals, and locks.</td>
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<td>63</td>
<td>Inspect switches, sensors, controls, actuator components, and circuits.</td>
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<td>64</td>
<td>Interpret customer programmable parameters.</td>
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<td>Perform on-engine inspections on electronic unit injectors (EUI).</td>
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<td>Install EUI and related components.</td>
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<td>Perform cylinder contribution test.</td>
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<td>Perform on-engine inspections on hydraulic electronic unit injectors (HEUI) and system electronic controls.</td>
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<td>69</td>
<td>Perform on-engine inspections on HEUI high-pressure oil supply and control systems.</td>
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<td>70</td>
<td>Perform on-engine inspections on high-pressure common rail (HPCR) type injection systems.</td>
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<td>71</td>
<td>Inspect high-pressure injection lines, hold downs, fittings and seals.</td>
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<td>72</td>
<td>Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems.</td>
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<td>73</td>
<td>Inspect clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch.</td>
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<td>Step</td>
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<td>Inspect hydraulic clutch slave and master cylinders, lines, and hoses.</td>
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<td>Inspect release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.</td>
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<td>Inspect single-disc clutch pressure plate and clutch disc.</td>
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<td>Inspect two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs.</td>
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<td>Inspect clutch brake assembly.</td>
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<td>87</td>
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<td>89</td>
<td>Inspect transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.</td>
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<td>Reinstall transmission.</td>
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<td>Inspect input shaft, gear, spacers, bearings, retainers, and slingers.</td>
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<td>Inspect operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.</td>
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<td>Inspect operation of automatic transmission electronic shift selectors, switches, displays, indicators, and wiring harnesses.</td>
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<td>102</td>
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<tr>
<td>127</td>
<td>Inspect drive axle temperature gauge, wiring harnesses, and sending unit/sensor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>Replace wheel bearings, seals and wear rings, and retaining hardware.</td>
<td>English: 12.5</td>
<td>Mathematics: A.1, A.4</td>
</tr>
<tr>
<td>129</td>
<td>Inspect ABS warning light operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>Diagnose ABS electronic control(s) and components.</td>
<td>Science: PH.11c</td>
<td></td>
</tr>
<tr>
<td>131</td>
<td>Identify poor stopping and wheel lock-up problems caused by failure of the ABS.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>Test operation of ABS air, hydraulic, electrical, and mechanical components.</td>
<td>Science: PH.11c</td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>Test ABS wheel speed sensors and circuits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>Bleed the ABS hydraulic circuits.</td>
<td>English: 12.5</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>Observe ATC warning light operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>Diagnose ATC electronic control(s) and components.</td>
<td>Science: PH.11c</td>
<td></td>
</tr>
<tr>
<td>137</td>
<td>Verify power line carrier (PLC) operations.</td>
<td>English: 12.5</td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>Install and center the steering wheel.</td>
<td>English: 12.5</td>
<td></td>
</tr>
<tr>
<td>139</td>
<td>Enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.</td>
<td>English: 12.5</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>Service fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>Service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
142 Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage.

143 Inspect frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures.

144 Inspect pintle hooks and draw bars, if applicable.

145 Verify instrument cluster operations using recommended electronic service tool(s). English: 12.5

146 Identify causes of data bus-driven gauge malfunctions. English: 12.5

147 Perform diagnostic procedures using recommended electronic service tool(s).

148 Check operation of keyless and remote lock/unlock devices.

149 Identify causes of data bus communication problems. English: 12.5

150 Verify the need for service or repair of HVAC systems based on unusual operating noises.

151 Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions.

152 Conduct performance test(s) on HVAC systems. English: 12.5

153 Retrieve diagnostic codes.

154 Identify causes of temperature control problems in the A/C system.

155 Check for contamination of refrigerant and lubricant.

156 Identify A/C system problems indicated by pressure gauge and temperature readings. English: 12.5

157 Identify A/C system problems indicated by visual, audible, smell, and touch procedures.

158 Perform A/C system leak test. English: 12.5

159 Recharge A/C system using appropriate equipment. Mathematics: A.1, A.4

160 Identify contamination in the A/C system components.

161 Perform diagnostic procedures using recommended electronic service tool(s).

162 Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation.

163 Replace A/C system pressure, thermal, and electronic devices.

164 Replace A/C compressor drive belts, pulleys, and tensioners. English: 12.5
<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>165</td>
<td>Service A/C compressor clutch components or assembly.</td>
</tr>
<tr>
<td>166</td>
<td>Correct A/C compressor lubricant level (if applicable).</td>
</tr>
<tr>
<td>167</td>
<td>Replace A/C compressor.</td>
</tr>
<tr>
<td>168</td>
<td>Replace A/C compressor mountings and hardware.</td>
</tr>
<tr>
<td>169</td>
<td>Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses.</td>
</tr>
<tr>
<td>170</td>
<td>Inspect A/C system hoses, lines, filters, fittings, and seals.</td>
</tr>
<tr>
<td>171</td>
<td>Test A/C system condenser.</td>
</tr>
<tr>
<td>172</td>
<td>Replace receiver/drier or accumulator/drier.</td>
</tr>
<tr>
<td>173</td>
<td>Test cab/sleeper refrigerant solenoid, expansion valve(s), and thermal bulb (capillary tube).</td>
</tr>
<tr>
<td>174</td>
<td>Replace orifice tube.</td>
</tr>
<tr>
<td>175</td>
<td>Test cab/sleeper evaporator core.</td>
</tr>
<tr>
<td>176</td>
<td>Repair evaporator housing and water drain.</td>
</tr>
<tr>
<td>177</td>
<td>Inspect A/C system service ports (gauge connections).</td>
</tr>
<tr>
<td>178</td>
<td>Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device.</td>
</tr>
<tr>
<td>179</td>
<td>Identify causes of outlet air temperature control problems in the HVAC system.</td>
</tr>
<tr>
<td>180</td>
<td>Identify window fogging problems.</td>
</tr>
<tr>
<td>181</td>
<td>Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration.</td>
</tr>
<tr>
<td>182</td>
<td>Inspect engine cooling and heating system hoses, lines, and clamps.</td>
</tr>
<tr>
<td>183</td>
<td>Inspect and test radiator, pressure cap, and coolant recovery system (surge tank).</td>
</tr>
<tr>
<td>184</td>
<td>Inspect water pump.</td>
</tr>
<tr>
<td>185</td>
<td>Inspect and test thermostats, by-passes, housings, and seals.</td>
</tr>
<tr>
<td>186</td>
<td>Refill with recommended coolant/additive package.</td>
</tr>
<tr>
<td>187</td>
<td>Inspect thermostatic cooling fan system (i.e., hydraulic, pneumatic, and electronic) and fan shroud.</td>
</tr>
<tr>
<td>188</td>
<td>Test heating system coolant control valve(s) and manual shut-off valves.</td>
</tr>
<tr>
<td>189</td>
<td>Inspect heater core.</td>
</tr>
<tr>
<td>190</td>
<td>Identify causes of HVAC electrical control system problems.</td>
</tr>
<tr>
<td>191</td>
<td>Test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices.</td>
</tr>
<tr>
<td>192</td>
<td>Test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices.</td>
</tr>
<tr>
<td>193</td>
<td>Test A/C related electronic engine control systems.</td>
</tr>
<tr>
<td>194</td>
<td>Test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices.</td>
</tr>
<tr>
<td>195</td>
<td>Test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices.</td>
</tr>
<tr>
<td>196</td>
<td>Test HVAC system electrical/electronic control panel assemblies.</td>
</tr>
<tr>
<td>197</td>
<td>Perform diagnostic procedures using recommended electronic service tool(s).</td>
</tr>
<tr>
<td>198</td>
<td>Identify causes of HVAC air and mechanical control problems.</td>
</tr>
<tr>
<td>199</td>
<td>Test HVAC system air and mechanical control panel assemblies.</td>
</tr>
<tr>
<td>200</td>
<td>Adjust HVAC system air and mechanical control cables and linkages.</td>
</tr>
<tr>
<td>201</td>
<td>Test HVAC system actuators and hoses.</td>
</tr>
<tr>
<td>202</td>
<td>Adjust HVAC system ducts, doors, and outlets.</td>
</tr>
<tr>
<td>203</td>
<td>Verify correct operation of certified equipment.</td>
</tr>
<tr>
<td>204</td>
<td>Recover A/C system refrigerant.</td>
</tr>
<tr>
<td>205</td>
<td>Recycle or properly dispose of refrigerant.</td>
</tr>
<tr>
<td>206</td>
<td>Store refrigerant.</td>
</tr>
<tr>
<td>207</td>
<td>Test recycled refrigerant for non-condensable gases.</td>
</tr>
<tr>
<td>208</td>
<td>Check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems).</td>
</tr>
<tr>
<td>209</td>
<td>Identify system type (closed and open) and proper operation.</td>
</tr>
<tr>
<td>210</td>
<td>Interpret system diagrams and schematics.</td>
</tr>
</tbody>
</table>
| 211 | Perform system temperature, pressure, flow, and cycle time tests. | English: 12.5  
Science: PH.7a, PH.7b |
<p>| 212 | Verify placement of equipment/component safety labels and placards. | English: 12.5 |
| 213 | Identify system fluid type. | English: 12.5 |
| 214 | Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems. | English: 12.5 |
| 215 | Determine pump type, rotation, and drive system. | English: 12.5 |
| 216 | Install pump. | English: 12.5 |
| 217 | Inspect pump inlet for restrictions and leaks. |  |
| 218 | Inspect pump outlet for restrictions and leaks. |  |
| 219 | Identify type of filtration system and flow direction. |  |
| 220 | Service filters and breathers. | English: 12.5 |
| 221 | Identify causes of system contamination. |  |
| 222 | Take a hydraulic oil sample for analysis. | English: 12.5 |
| 223 | Check reservoir fluid level and condition. |  |
| 224 | Repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines. |  |
| 225 | Diagnose causes of component leakage, damage, and restriction. |  |
| 226 | Inspect hoses and connections (length, size, routing, bend radii, and protection). |  |
| 227 | Assemble hoses, tubes, connections and fittings in accordance with manufacturer’s specifications. |  |
| 228 | Inspect fitting seals and sealants. |  |
| 229 | Pressure test system safety relief valve. | English: 12.5 |
| 230 | Perform control valve operating pressure and flow tests. | English: 12.5 |
| 231 | Test valve controls (i.e., electrical/electronic, mechanical, pneumatic). |  |
| 232 | Identify causes of control valve leakage (internal/external). |  |
| 233 | Inspect pilot control valve linkages, cables, and power take-off (PTO) controls. |  |
| 234 | Identify actuator type. |  |
| 235 | Identify the cause of seal failure. |  |
| 236 | Identify the cause of incorrect actuator movement and leakage (internal and external). |  |
| 237 | Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage. |  |</p>
<table>
<thead>
<tr>
<th></th>
<th>Repair and/or replace actuators in accordance with manufacturers' recommended procedures.</th>
<th>English: 12.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inspect actuators for dents, cracks, damage, and leakage.</td>
<td>History and Social Science: GOVT.9, GOVT.15, GOVT.16</td>
</tr>
<tr>
<td></td>
<td>Purge and/or bleed system in accordance with manufacturers' recommended procedures.</td>
<td>English: 12.5</td>
</tr>
</tbody>
</table>

**Entrepreneurship Infusion Units**

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.” Teachers can find the infusion/unit in the course listing.
Appendix: Credentials and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- ASE Certification Examinations
- ASE Entry-Level Certification Examinations
- College and Work Readiness Assessment (CWRA+)
- Customer Service Examination
- Customer Service Specialist (CSS) Examination
- Mobile Communications and Electronics Installer (MCEI) Examination
- National Career Readiness Certificate Assessment
- Professional Communications Certification Examination
- Workplace Readiness Skills for the Commonwealth Examination

Career Cluster: Transportation, Distribution and Logistics

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
</table>
| Facility and Mobile Equipment Maintenance | Automotive Service Technician, Mechanic  
Diesel Service Technician  
Electrical and Electronic Installer  
Electrical and Electronic Repairer  
Service Technician                  |