

Cooper Machinery Services Training Topics		09/28/23
Competency #	Title	Description/Competency Objectives
0012K	<b>Compression Equipment: Introduction to Integral Engines-Compressors</b>	<ul style="list-style-type: none"> <li>Understands the difference between Integral and Separable compressors</li> <li>Describes key engine terminology and product overview</li> <li>Performs basic compression related calculations</li> </ul>
0061K	<b>Safety. Natural Gas Safety</b>	<ul style="list-style-type: none"> <li>Understands the hazards associated with natural gas and natural gas facilities (including explosive and fire hazards, asphyxiation, hydrogen sulfide (H2S), black powder (iron sulfide), high pressure gas, and cold/hot temperatures)</li> <li>Explains the safety responsibilities and precautions that should be taken by personnel working around natural gas (including gas monitoring, electrical classifications, confined space entry and lockout/tagout).</li> </ul>
0063K	<b>Safety. Safety Briefing for Hands-On Training</b>	<p>Identifies hazards and understands safety procedures associated with performing hands-on activities in the training area or workshop.</p> <ul style="list-style-type: none"> <li>Emergency evacuation and warning sounds in the workshop</li> <li>Activity limitations or boundaries in place during the workshop activities</li> <li>Required Personal Protective Equipment (hardhat, gloves, steel toe boots, hearing, etc.)</li> <li>Pinch points (barring, process gas pressure, crane/lifting devices)</li> <li>Basic hand tool safety (as applicable)</li> <li>Lifting and Rigging procedures (where applicable)</li> <li>Lock-Out / Tag-Out (LOTO) procedure (where applicable)</li> <li>Incident/accident response and reporting</li> <li>Job Safety Awareness (JSA) of workshop and activities</li> </ul>
0500K-AJAX	<b>AJAX Product Overview</b>	<ul style="list-style-type: none"> <li>Describes basic product line overview for AJAX equipment</li> <li>Describes common layout and technical specifications for AJAX equipment</li> <li>Describes AJAX product developments and upgrades (emissions, superchargers, catalysts, pre-combustion chambers, capacity control plugs and unloaders)</li> </ul>
0500K-Superior825	<b>Superior Engine Product Overview</b>	<ul style="list-style-type: none"> <li>Describes basic product line overview for Superior 825 Engines</li> <li>Describes common layout and technical specifications</li> <li>Describes product developments and upgrades</li> </ul>
0500K-SuperiorHSR	<b>Superior Compressor Product Overview</b>	<ul style="list-style-type: none"> <li>Describes basic product line overview for Superior High Speed Recip (HSR) Compressors</li> <li>Describes common layout and technical specifications</li> <li>Describes product developments and upgrades</li> </ul>
0620S	<b>Identify Alignment &amp; Alignment Methods</b>	<ul style="list-style-type: none"> <li>Explains the purpose of shaft alignment, describes the difference between cold alignment and hot alignment, identifies types of misalignment, and identifies various types of pre-alignment checks.</li> </ul>
0900K	<b>Fundamentals of Engines and Compressors Course Introduction</b>	<ul style="list-style-type: none"> <li>Course Introduction to Fundamentals of Engines and Compressors Training Class</li> <li>Review course objectives and syllabus</li> <li>Introduction to basic safety and hazards</li> </ul>
0900K-JM	<b>Integral Engine-Compressor Course Introduction - Joe Mares Instructor</b>	<ul style="list-style-type: none"> <li>Course Introduction to Integral Engine Compressor Training Class</li> <li>Review of course objectives and syllabus</li> <li>Introduction to basic safety and hazards</li> </ul>
0900K-RLA	<b>Integral Engine-Compressor Class Introduction - Randy Anderson Instructor</b>	<ul style="list-style-type: none"> <li>Course Introduction to Integral Engine Compressor Training Class</li> <li>Review of course objectives and syllabus</li> <li>Introduction to basic safety and hazards</li> </ul>
0910K	<b>High Speed Reciprocating (HSR) Compressor Class Introduction</b>	<ul style="list-style-type: none"> <li>Course Introduction to High Speed Separable Compressor Training Class</li> <li>Review of course objectives and syllabus</li> <li>Introduction to basic safety and hazards</li> </ul>
1100K-2SC	<b>Reciprocating Engine: Identify Major Mechanical Components of Integral Engines</b>	<ul style="list-style-type: none"> <li>Identifies the components and operation of the power train (frame, crankshaft, flywheel, power cylinders &amp; liners, power pistons, power heads, and power connecting rods)</li> <li>Identifies the components and operation of the valve train (camshaft, pushrods, lifters, rocker arms, and fuel valve)</li> </ul>
1100K-4SC	<b>Reciprocating Engine: Identify Major Mechanical Components of High Speed Engines</b>	<ul style="list-style-type: none"> <li>Identifies the components and operation of the power train (frame, crankshaft, flywheel, power cylinders &amp; liners, power pistons, power heads, and power connecting rods.</li> <li>Identifies the components and operation of the valve train (camshaft, pushrods, lifters, rocker arms, and power valves (intake, exhaust, and fuel).</li> </ul>
1100K-Diesel	<b>Reciprocating Engine: Identify Major Mechanical Components of Diesel Engines</b>	<ul style="list-style-type: none"> <li>Identifies the components and operation of the power train (frame, crankshaft, flywheel, power cylinders &amp; liners, power pistons, power heads, and power connecting rods.</li> <li>Identifies the components and operation of the valve train (camshaft, pushrods, lifters, rocker arms, and power valves (intake and exhaust) and fuel injectors.</li> </ul>

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1150T	<b>Reciprocating Equipment: Inspect Frame and Foundation (Soft Foot and Anchor Bolt Torque)</b>	<ul style="list-style-type: none"> <li>• Prepares for Frame and Foundation (reviews OEM manual and work documentation, gathers proper tools and parts, and performs pre-work safety activities).</li> <li>• Verifies foundation bolts for proper torque and soft foot and records "as left" conditions.</li> <li>• Verifies and performs proper bolt torquing to foundation bolts and records "as left" conditions. Check Engine to Compressor Alignment</li> </ul>
1151T	<b>Reciprocating Equipment: Conduct A Crankshaft Web Deflection Survey</b>	<ul style="list-style-type: none"> <li>• Explains the purpose of a web deflection survey.</li> <li>• Demonstrate how to prepare and collect crankshaft web deflection data.</li> <li>• Analyzes and interprets results of web deflection survey</li> <li>• Identifies corrective action (as required)</li> <li>• Documents web deflection survey</li> </ul>
1152T	<b>Reciprocating Equipment: Measure Bearing Clearances and Perform Main Bearing Bump Checks</b>	<ul style="list-style-type: none"> <li>• Measure clearances on main bearings, rod bearings, and pin bushings. Record clearance data.</li> <li>• Perform main bearing bump check to measure and record clearances.</li> </ul>
1210K	<b>Reciprocating Engine – 2 Stroke Cycle - Describe Sequence of Events and Performance Basics</b>	<ul style="list-style-type: none"> <li>• Describes the sequence of events for 2-stroke cycle engines, engine timing and pressure-volume graph (PV), normal and abnormal combustion</li> </ul>
1220K	<b>Reciprocating Engine – 4 Stroke Cycle - Describe Sequence of Events and Performance Basics</b>	<ul style="list-style-type: none"> <li>• Describes the sequence of events for 4-stroke cycle engines, engine timing and pressure-volume graph (PV), normal and abnormal combustion</li> </ul>
1250K	<b>Reciprocating Engine: Understand Concepts Of Engine Combustion</b>	<ul style="list-style-type: none"> <li>• Explains the following basic combustion concepts: the fire triangle, flame front velocity, LEL and UEL, stoichiometric mixtures, and the parabolic burning curve</li> <li>• Explains the affects and effects of combustion related to emissions formation, ignition timing, fuel quality, high energy ignition, and abnormal operating conditions</li> </ul>
1250K-Diesel	<b>Reciprocating Engine: Understand Concepts Of Diesel Engine Combustion</b>	<ul style="list-style-type: none"> <li>• Explains the following basic combustion concepts: the fire triangle, LEL and UEL, stoichiometric mixtures, and the parabolic burning curve.</li> <li>• Describes the four phases of diesel combustion (Ignition delay, Rapid/uncontrolled combustion, Controlled combustion, and After burning.</li> <li>• Understands how combustion impacts the development of heat and pressure in the combustion chamber to produce torque and horsepower.</li> <li>• Understands some of the common factors and problems that will impact the diesel combustion quality.</li> </ul>
1270K	<b>Reciprocating Engine: Describe Emission and Control Technologies for Reciprocating Engines</b>	<ul style="list-style-type: none"> <li>• Explain basic air pollutants and emissions</li> <li>• Understand how emissions are formed in gas engines</li> <li>• Describes the components and operation of common emissions control technologies including: lean combustion, pre-combustion chambers (PCC) /jet cells, high pressure fuel injection, and catalytic control (where applicable)</li> </ul>
1284T	<b>Reciprocating Engines: Camshaft and Auxiliary Drive Inspection and Adjustment</b>	<ul style="list-style-type: none"> <li>• Inspects condition of camshaft and auxiliary drive chain, sprocket, gears, and bearings.</li> <li>• Inspects camshaft and auxiliary drive chains and Adjusts tightness.</li> <li>• Checks camshaft alignment and thrust clearance.</li> <li>• Inspects camshaft lobes and bearing condition.</li> <li>• Verifies and adjusts camshaft timing (including verification of Top Dead Center (TDC)).</li> <li>• Documents "as left" condition.</li> </ul>
1285T-Diesel	<b>Reciprocating Engines: Remove and Install Diesel Power Head</b>	<ul style="list-style-type: none"> <li>• Removes power head and records "as found" conditions.</li> <li>• Inspects and prepares replacement power head for installation.</li> <li>• Installs power head and properly reset valve train clearances.</li> <li>• Documents and verifies proper operation of replacement power head.</li> </ul>
1286T	<b>Reciprocating Engines: Pulls, Inspect, and Replaces Power Valves</b>	<ul style="list-style-type: none"> <li>• Pulls/Removes power valves from power head.</li> <li>• Inspects and records "as found" conditions including valve recession.</li> <li>• Replace valve seats and power valves (as needed).</li> <li>• Installs valve springs and rocker arm assemblies (as needed).</li> <li>• Documents "as left" condition.</li> </ul>
1288T-Diesel	<b>Reciprocating Engines: Diesel Fuel Pump and Injector Maintenance</b>	<ul style="list-style-type: none"> <li>• Removes and visually inspects fuel injector.</li> <li>• Performs fuel injector rig test to determine pop pressure and spray pattern.</li> <li>• Installs fuel injector.</li> <li>• Verifies and adjusts fuel pump timing.</li> <li>• Performs fuel rack adjustment.</li> <li>• Inspects governor, control cylinder, and associated rack linkage.</li> <li>• Documents "as left" conditions.</li> </ul>

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1300K	<b>Reciprocating Engines: Describe Elements and Operation of the Air Delivery &amp; Exhaust Systems</b>	<ul style="list-style-type: none"> <li>• Describes the different types of engine air delivery and exhaust systems</li> <li>• Identifies air and exhaust flow paths and components including both turbocharged versus naturally aspirated engines</li> <li>• Explains the theory of operation of different air manifolds</li> <li>• Explains the purpose, elements, and operation of the Intercooler</li> <li>• Understands the difference between a wet and dry manifold.</li> <li>• Understands how to prepare an engine "air map"</li> </ul>
1311T	<b>Reciprocating Engines: Perform Turbocharger Inspection (Including Visual Inspection, Hand Check for Slop, Thrust, &amp; Rub)</b>	<ul style="list-style-type: none"> <li>• Conducts visual turbocharger inspection</li> <li>• Conducts hand check for slop, thrust, and rub</li> <li>• Performs operational review of turbocharger (verifying pressures (oil and air), speed, drift down time)</li> <li>• Documents turbocharger inspection</li> </ul>
1320K	<b>Reciprocating Engines: Describe Elements and Operation of the Fuel Delivery System &amp; Governor</b>	<ul style="list-style-type: none"> <li>• Explains the components and operation of the fuel delivery system including fuel supply, carburetion, fuel injection, and governors</li> </ul>
1320K - Diesel	<b>Reciprocating Engines: Describe Elements and Operation of Diesel Fuel Delivery System &amp; Governor</b>	<ul style="list-style-type: none"> <li>• Explains the components and operation of a diesel fuel delivery system including: <ul style="list-style-type: none"> <li>• Fuel supply, transfer pumps and filters,</li> <li>• Low pressure fuel system and main fuel pump,</li> <li>• High pressure fuel system including high pressure fuel injection pumps and fuel injectors, and</li> <li>• Speed control and associated control linkages.</li> </ul> </li> </ul>
1320S-Hyperfuel	<b>Reciprocating Engines: Describe Elements and Operation of the High Pressure Fuel Delivery System</b>	<ul style="list-style-type: none"> <li>• Explains the components and operation of the HyperFuel high pressure fuel delivery system including fuel supply, solenoid driver module (SDM) control equipment, and Human-Machine Interface (HMI)(electronic part to component).</li> <li>• Hands-On review of the use and adjustment of the HyperFuel system.</li> </ul>
1321S-HyperBalance	<b>Reciprocating Engines: Describe Elements and Operation of the HyperBalance System</b>	<ul style="list-style-type: none"> <li>• Explains the components and operation of the HyperBalance system, software review, and troubleshooting.</li> <li>• Hands-On review of the use and adjustment of the HyperBalance system.</li> </ul>
1321T	<b>Reciprocating Engines: Perform Engine Balance</b>	<ul style="list-style-type: none"> <li>• Explains the reasons for performing an engine balance giving symptoms and benefits of balancing an engine.</li> <li>• Describes the engine balancing process giving information that will help you decide whether to raise or lower cylinders.</li> <li>• Demonstrates proper use of the balance tool or equipment.</li> <li>• Performs engine balance</li> <li>• Documents balance activity</li> </ul>
1321T-Diesel	<b>Reciprocating Engines: Perform Engine Balance on Diesel Engine Using Fuel Racks, Governor, and Linkages</b>	<ul style="list-style-type: none"> <li>• Explains the reasons for performing an engine balance giving symptoms and benefits of balancing an engine.</li> <li>• Describes the engine balancing process giving information that will help you decide whether to raise or lower cylinders.</li> <li>• Demonstrates proper use of the balance tool or equipment.</li> <li>• Performs engine balance</li> <li>• Documents balance activity</li> </ul>
1400K	<b>Reciprocating Equipment: Describe Lubrication System for the Frame and Running Gear</b>	<ul style="list-style-type: none"> <li>• Explains the purpose of lubrication oil</li> <li>• Identifies the main oil lubrication system flow path and its components</li> <li>• Explains lubrication oil composition and viscosity</li> <li>• Identifies basic elements of oil sampling and analysis and the effects of equipment operation on oil impurities and life</li> </ul>
1400K-AJAX	<b>Reciprocating Equipment: Describe Lubrication System for the Frame and Running Gear for AJAX Engines</b>	<ul style="list-style-type: none"> <li>• Explains the purpose of lubrication oil.</li> <li>• Identifies the main oil lubrication system flow path and its components for AJAX units.</li> <li>• Explains lubrication oil composition and viscosity</li> <li>• Identifies basic elements of oil sampling and analysis and the effects of equipment operation on oil impurities and life.</li> </ul>
1450K	<b>Reciprocating Equipment: Describe Elements and Operation of the Force Feed Lubrication System</b>	<ul style="list-style-type: none"> <li>• Identifies components and describes the operation of force feed lubrication systems (Point to Point and Divider Block)</li> <li>• Explains the basics of force feed lubrication monitoring and related alarm and shutdown devices</li> </ul>
1452T	<b>Reciprocating Equipment: Perform Maintenance on Force Feed Lubrication System</b>	<ul style="list-style-type: none"> <li>• Prepares for force feed lubrication system maintenance (reviews OEM manual and work documentation, gathers proper tools and parts, and performs pre-work safety activities).</li> <li>• Performs force feed lubricator pump replacement.</li> <li>• Performs divider block replacement.</li> <li>• Purges and tests the operation of the force feed lubrication.</li> <li>• Documents work performed and "as left" conditions.</li> <li>• Oil lubricator - Check distribution block, oil level, and lube rate. Adjust as necessary.</li> <li>• Lubricator Pumps and Divider Block - verify proper operation</li> <li>• Replace Pro-Flo battery</li> </ul>

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1500K	<b>Reciprocating Engines: Describe Elements and Operation of the Cooling System</b>	<ul style="list-style-type: none"> <li>• Describes the different engine cooling systems including jacket water, scavenging air, and oil</li> <li>• Describes basic coolant analysis</li> <li>• Identifies cooling system components and flow paths</li> </ul>
1700K	<b>Reciprocating Engines: Identify Basic Engine Safety and Controls Systems</b>	<ul style="list-style-type: none"> <li>• Explains common safety standards, codes, area classifications and shutdown control strategies</li> <li>• Explains P&amp;ID diagrams and their role in adjusting engine controls for engine speed control (governor), air-fuel ratio, ignition timing, and pre-combustion chamber</li> </ul>
1750K	<b>Reciprocating Engine: Identify Elements of a CD Ignition Systems</b>	<ul style="list-style-type: none"> <li>• Identifies the components, operation, and troubleshooting of typical capacitive discharge (CD) spark ignition systems</li> <li>• Describes primary, secondary, and ionization voltage</li> <li>• Identifies spark maintenance, wear, and failure</li> </ul>
1750S-AltronicXL	<b>Reciprocating Engines: Identify Elements Of The Ignition System - Altronic Ignition System (CPU-XL)</b>	<ul style="list-style-type: none"> <li>• Identify the components, operation, and troubleshooting of the Altronic XL capacitive discharge (CD) spark ignition systems.</li> <li>• Discuss spark maintenance, wear, and failure.</li> <li>• Review the Altronic XL Operators manual.</li> <li>• Hands-on review of the use and adjustment of the Altronic XL</li> </ul>
1810K	<b>Reciprocating Engine: Describes General Operations and Maintenance</b>	<ul style="list-style-type: none"> <li>• Understands general operations of reciprocating engines including important operating parameters to be monitored and operational adjustments</li> <li>• Understands the recommended maintenance schedule for reciprocating engines</li> </ul>
1810K-AJAX	<b>Reciprocating Package: Describe AJAX General Operations and Maintenance</b>	<ul style="list-style-type: none"> <li>• Understands general operations of AJAX engines including important operating parameters to be monitored and operational adjustments</li> <li>• Understands the recommended maintenance schedule for AJAX engines</li> <li>• Understands any special tools and procedures that may apply to AJAX units</li> </ul>
1810K-Diesel	<b>Reciprocating Diesel Engine: Describe General Operations and Maintenance</b>	<ul style="list-style-type: none"> <li>• Understands general operations of diesel engines including important operating parameters to be monitored and operational adjustments.</li> <li>• Understands the recommended maintenance schedule for diesel engines.</li> </ul>
1810K-Superior825	<b>Reciprocating Package: Describe Superior Engine General Operations and Maintenance</b>	<ul style="list-style-type: none"> <li>• Understands general operations of Superior engines including important operating parameters to be monitored and operational adjustments.</li> <li>• Understands the recommended maintenance schedule for Superior engines.</li> <li>• Understands any special tools and procedures that may apply to Superior units.</li> </ul>
1810K-SuperiorHSR	<b>Reciprocating Package: Describe Superior Compressor General Operations and Maintenance</b>	<ul style="list-style-type: none"> <li>• Understands general operations of Superior compressor including important operating parameters to be monitored and operational adjustments.</li> <li>• Understands the recommended maintenance schedule for Superior compressors.</li> <li>• Understands any special tools and procedures that may apply to Superior compressors.</li> </ul>
2000K	<b>Reciprocating Compressor: Identify Compressor Fundamentals &amp; Sequence of Events</b>	<ul style="list-style-type: none"> <li>• Explains the key terminology (single and multistage compression, single and double acting, suction and discharge pressure, flow, head end, crank end, load/unloading sequence)</li> <li>• Describes typical compressor layout with cylinder and valve numbering</li> <li>• Describes the sequence of events for reciprocating compressors (re-expansion, suction, compression, and discharge)</li> <li>• Understands rod load and rod pin reversal</li> </ul>
2100K	<b>Reciprocating Compressor: Identify Major Mechanical Components</b>	<ul style="list-style-type: none"> <li>• Identifies and describes the function of major components of a reciprocating compressor (frame, crankshaft, crosshead guide, compressor cylinder, piston, rider bands and compressor rings, cylinder head, connecting rod, piston rod, crosshead, and distance piece)</li> </ul>
2102T	''	<ul style="list-style-type: none"> <li>• Prepares for compressor piston and rod maintenance (reviews OEM manual and work documentation, gathers proper tools and parts, and performs pre-work safety activities).</li> <li>• Removes compressor piston and compressor rod and documents "as found" conditions.</li> <li>• Removes pressure and oil wiper packing and documents "as found" conditions.</li> <li>• Inspects compressor cylinder and documents "as found" conditions.</li> <li>• Installs pressure and oil wiper packing.</li> <li>• Installs compressor piston and compressor rod.</li> <li>• Documents work performed.</li> </ul>
2104T	<b>Reciprocating Compressor: Remove, Inspect, and Install Crosshead and Pin</b>	<ul style="list-style-type: none"> <li>• Prepares for crosshead maintenance (reviews OEM manual and work documentation, gathers proper tools and parts, and performs pre-work safety activities).</li> <li>• Removes crosshead and crosshead pin</li> <li>• Inspects crosshead guide/"doghouse", crosshead, and crosshead pin and bushing and documents "as found" conditions.</li> <li>• Prepares crosshead for installation (changing shoes or pin bushing as needed).</li> <li>• Installs crosshead and crosshead pin.</li> <li>• Documents work performed.</li> </ul>

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2110T	<b>Reciprocating Compressor: Verify Compressor Alignment and Rod Runout by Performing Gas Path Integrity Inspection</b>	<ul style="list-style-type: none"> <li>• Prepares for Gas Path Integrity Inspection (reviews OEM manual and work documentation, gathers proper tools and parts, and performs pre-work safety activities).</li> <li>• Performs gas path integrity inspection and records "as left" conditions.</li> </ul>
2130K	<b>Reciprocating Compressor: Describe Elements and Operation of Compressor Valves</b>	<ul style="list-style-type: none"> <li>• Describe the basic construction and operation of compressor valves</li> <li>• Identifies the types of compressor valves and valve elements</li> <li>• Describes basic wear and maintenance of compressor valves</li> </ul>
2132T	<b>Reciprocating Compressors: Remove &amp; Install Compressor Valves</b>	<ul style="list-style-type: none"> <li>• Prepares for compressor valve maintenance (reviews OEM manual and work documentation, gathers proper tools and parts, and performs pre-work safety activities).</li> <li>• Removes compressor valve and documents "as found" conditions.</li> <li>• Inspects replacement compressor valve.</li> <li>• Installs compressor valve, verifies proper installation, and documents "as left" conditions.</li> </ul>
2150K	<b>Reciprocating Compressor: Describe Capacity Control / Unloading Devices</b>	<ul style="list-style-type: none"> <li>• Identifies the purpose of capacity control / unloading devices</li> <li>• Describes the theory of operation of capacity control / unloading devices and explains the effects of these devices on gas flow, horsepower, and the relationship of pressure to volume graph</li> </ul>
2170K	<b>Reciprocating Compressors: Compressor Rod Packing</b>	<ul style="list-style-type: none"> <li>• Identifies the basic components and operation of compressor rod packing (packing case/cups, pressure packing rings, and oil wiper packing rings)</li> <li>• Describes the types of pressure packing and oil wiper packing geometry and materials</li> <li>• Explains the normal wear and failure modes including signs of a leak</li> </ul>
2850K	<b>Reciprocating Compressor: Understands Basic Troubleshooting</b>	<ul style="list-style-type: none"> <li>• Understands basic process and knowledge needed to perform reciprocating compressor troubleshooting</li> <li>• Demonstrates how to use the OEM manual to diagnose and identify probable corrections for compressor problems</li> <li>• Understands key compressor operating and performance parameters including normal and abnormal conditions</li> </ul>