

Course Name: **Fundamentals of Integral Engines and Compressors**
Cooper-Bessemer, Worthington, Clark/D-R, I-R, and AJAX

Course Length: 36 hours classroom

Prerequisites: None

Target Audience: Operators, mechanics, technicians, engineers, and maintenance / equipment specialists responsible for the safe day to day operation, maintenance, and improvements of integral engine/compressors

Goal: Knowledge & comprehension of the equipment components and their function, basic operation, and common maintenance practices used with the integral engine-compressor unit and accessories.

| CLASSROOM ACTIVITIES/SCHEDULE | Time (Hrs) |
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| DAY 1 | |
| Fundamentals of Engine-Compressor Course Introduction (0900K) <ul style="list-style-type: none"> • Instructor and Student introductions • Review of course objectives and syllabus • Introduction to important safety and hazards | 1 |
| Compression Equipment – Introduction to Integral Engines-Compressors (0012K) <ul style="list-style-type: none"> • Understands the difference between Integral and Separable compressors • Describes key engine terminology and product overview. • Performs basic compression related calculations. | 1 |
| Reciprocating Engine: Identify Major Mechanical Components (1100K) <ul style="list-style-type: none"> • Identifies the components and operation of the power train (frame, crankshaft, flywheel, power cylinders & liners, power pistons, power heads, and power connecting rods. • Identifies the components and operation of the valve train (camshaft, pushrods, lifters, rocker arms, and power valves (intake, exhaust, and fuel). | 6 |
| DAY 2 | |
| Reciprocating Engine: 2 Stroke Cycle - Describe Sequence of Events and Performance Basics (1210K) <ul style="list-style-type: none"> • Describes the sequence of events for 2-stroke cycle engines, engine timing and pressure-volume graph (PV), normal and abnormal combustion. | 1.5 |
| Reciprocating Engine: 4 Stroke Cycle - Describe Sequence of Events and Performance Basics (1220K) <ul style="list-style-type: none"> • Describes the sequence of events for 4-stroke cycle engines, engine timing and pressure-volume graph (PV), normal and abnormal combustion. | 0.5 |

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| <p>Reciprocating Engines: Describe Elements and Operation of the Air Delivery & Exhaust Systems (1300K)</p> <ul style="list-style-type: none"> • Describes the different types of engine air delivery and exhaust systems. • Identifies air and exhaust flow paths and components including both turbocharged versus naturally aspirated engines. • Explains the theory of operation of different air pressure manifolds. | <p>1.5</p> |
| <p>Reciprocating Engines: Describe Elements and Operation of the Fuel Delivery System (1320K)</p> <ul style="list-style-type: none"> • Explains the components and operation of the fuel delivery system including fuel supply, carburetion, fuel injection, and governors. | <p>0.5</p> |
| <p>Reciprocating Equipment: Describe Lubrication System for the Frame and Running Gear (1400K)</p> <ul style="list-style-type: none"> • Explains the purpose of lubrication oil. • Identifies the main oil lubrication system flow path and its components. • Explains lubrication oil composition and viscosity • Identifies basic elements of oil sampling and analysis and the effects of equipment operation on oil impurities and life. | <p>2</p> |
| <p>Reciprocating Engines: Describe Elements and Operation of the Cooling System (1330K)</p> <ul style="list-style-type: none"> • Describes the different engine cooling systems including jacket water, scavenging air, and oil. • Describes basic coolant analysis. • Identifies cooling system components and flow paths. | <p>2</p> |
| <p>DAY 3</p> | |
| <p>Reciprocating Engine: Understand Concepts of Basic Engine Combustion (1250K)</p> <ul style="list-style-type: none"> • Explains the following basic combustion concepts: the fire triangle, flame front velocity, LEL and UEL, stoichiometric mixtures, and the parabolic burning curve. • Explains the affects and effects of combustion related to emissions formation, ignition timing, fuel quality, high energy ignition, and abnormal operating conditions. | <p>2</p> |
| <p>Reciprocating Engine: Describe Emission Control Technologies for Reciprocating Engines (1270K)</p> <ul style="list-style-type: none"> • Describes the components and operation of common emissions control technologies including lean combustion, pre-combustion chambers/jet cells, high pressure fuel injection, and catalytic control. | <p>2</p> |
| <p>Reciprocating Engine: Identify Elements of a CD Ignition Systems (1750K)</p> <ul style="list-style-type: none"> • Identifies the components, operation, and troubleshooting of typical capacitive discharge (CD) spark ignition systems. Describes primary, secondary, and ionization voltage. Identifies spark maintenance, wear, and failure. | <p>2</p> |
| <p>Reciprocating Engine: Identify Basic Safety and Controls Systems (1700K)</p> <ul style="list-style-type: none"> • Explains common safety standards, codes, area classifications and shutdown control strategies. • Explains P&ID diagrams and their role in adjusting engine controls for engine speed control (governor), air-fuel ratio, ignition timing, and pre-combustion chamber. | <p>2</p> |

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| <p>Reciprocating Engine: General Operations and Maintenance (1810K)</p> <ul style="list-style-type: none"> • Understands general operations of reciprocating engines including important operation parameters to be monitored and operational adjustments. • Understand the recommended maintenance schedule for reciprocating engines. | 1 |
| DAY 4 | |
| <p>Reciprocating Compressor: Identify Major Mechanical Components (2100K)</p> <ul style="list-style-type: none"> • 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). | 4 |
| <p>Reciprocating Compressor: Identify Compressor Fundamentals & Sequence of Events (2000K)</p> <ul style="list-style-type: none"> • Explains the different types of reciprocating gas compressors. • Describes the sequence of events for reciprocating compressors (single acting and double acting). • Explains a Pressure-Volume (P-V) graph, rod load, and rod pin reversal. | 2 |
| <p>Reciprocating Compressor: Describe Elements and Operation of Compressor Valves (2130K)</p> <ul style="list-style-type: none"> • Describe the basic construction and operation of compressor valves. • Identifies the types of compressor valves and valve elements. • Describes basic wear and maintenance of compressor valves. | 1 |
| <p>Reciprocating Compressor: Describe Capacity Control / Unloading Devices (2150K)</p> <ul style="list-style-type: none"> • Identifies the purpose of capacity control / unloading devices. • 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. | 1 |
| DAY 5 | |
| <p>Reciprocating Compressors: Compressor Rod Packing (2170K)</p> <ul style="list-style-type: none"> • Identifies the basic components and operation of compressor rod packing (packing case/cups, pressure packing rings, and oil wiper packing rings). • Describes the types of pressure packing and oil wiper packing geometry and materials • Explains the normal wear and failure modes including signs of a leak. | 1 |
| <p>Reciprocating Equipment: Describe Elements and Operation of the Force Feed Lubrication System (1450K)</p> <ul style="list-style-type: none"> • Identifies components and describes the operation of force feed lubrication systems (Point to Point and Divider Block). • Explains the basics of force feed lubrication monitoring and related alarm and shutdown devices. | 1 |
| <p>Reciprocating Compressor: Basic Troubleshooting (2850K)</p> <ul style="list-style-type: none"> • Understand basic process and knowledge needed to perform reciprocating compressor troubleshooting. • Demonstrate how to use the OEM manual to diagnose and identify probable corrections for compressor problems. • Understand key compressor operating and performance parameters including normal and abnormal conditions. | 0.5 |

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| Question and Answer Session | 0.5 |
| Written Course Exam (Open Notes) | 1 |