COMPRESSOR TRAINING
Viking Range

PRODUCT RANGE

- 25/300 - 25 bar (365 psi), 30m³/min (1070 cfm)
- 25/330 - 25 bar (365 psi), 33m³/min (1170 cfm)

SUMMARY

- The compressor can be divided in the following subsystems
  - ENGINE and AIREND
  - LUBRICATION & COOLING SYSTEM
  - SEPARATION SYSTEM
  - AIR FLOW REGULATION SYSTEM
  - INSTRUMENT/CONTROL PANEL
  - ELECTRICAL WIRING
- Troubleshooting
**ENGINE CAT**

- **CAT C15**
- 6 cylinders
- 15.2L displacement
- Power ratings @ 1800 RPM:
  - 354kW (475hp) – 25/300
  - 403kW (540hp) – 25/330
- Turbocharged and after-cooled
- MEUI mechanically actuated, electronically controlled unit injection
- Tier III certified
- 24 Volt Electrics

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**AIREND**

- Casing houses two screw-type rotors mounted on ball and roller bearings.
- Diesel engine drives the male rotor through heavy-duty coupling.
- Mechanical seal used to seal the shaft.
- Gear sets allow to change rotor speed and therefore air output.
- Two different airends used on Viking range:
  - Single stage on 10/370, 10/455
  - Two stages on 25/300, 25/330

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**HR2.5 HIGH PRESSURE AIREND**

- 2-stage airend
- Oil pump driven by second stage
COMPRESSOR OIL SYSTEM

- Functions of the oil system:
  - Lubricating the rotors, airend bearings and mechanical seals
  - Sealing the clearances between the airend rotors
  - Cooling of the airend. Heat is generated during air compression.
- The oil flows due to the air pressure. Only the two-stage airend uses an oil pump.
COMPRESSOR OIL CIRCUIT

SEPARATOR/RECEIVER TANK

- Stores the compressed air and oil.
- Pressure in the tank is forcing the oil through the system.
- An oil level indicator is provided.
- Assists in the oil cooling with fresh air passing around.

OIL TEMP. BYPASS VALVE

- Allows to regulate the oil temperature around 85°C.
- Keeping the oil hot enough allows to reduce the water condensation in the compressor.

Tip: never remove the thermostat as the oil would flow through the least restriction path and cooling would be impaired!
OIL TEMP. BYPASS VALVE

- Cold oil
- Hot oil

COOLER PACKAGE

Check every day and clean if necessary to ensure high efficiency.

COOLING FAN

- The fan is a pusher type, fresh air flows around the engine.
- Make sure the compressor doors are closed during operation to prevent overheating!
### OIL FILTERS

- Provide 10 microns filtration.
- Spring-loaded bypass valve is integrated in filter head.

### SEPARATION SYSTEM

- Functions of the separation system:
  - Removing the oil contained in the compressed air
- Most of the oil is removed from the air through a specially shaped baffle in the separator tank.
- The remaining oil is removed by the separator element.

### SEPARATION SCHEMATIC
**SEPARATOR/RECEIVER TANK**

![Separator/Receiver Tank Diagram]

**SCAVENGE DROP TUBES**

- The scavenge tube removes the oil trapped by the separator element.
- It extends up to approximately 6 to 12mm over the element’s bottom.

> Tip: Always check scavenge tube length when replacing separator element

![Scavenge Drop Tubes](Image)

**SCAVENGE LINE**

- Returns to air inlet.
- Orifice is located in the elbow connector.
- It is designed to scavenge the oil while limiting the loss of air flow.

> Tip: Look for clogged scavenge lines in case of oil carry over!
SAFETY VALVE

- Valve is on the oil side of the element where pressure is maximum when the separator element is blocked.
- Sensor allows to detect if the valve opens.

MINIMUM PRESSURE VALVE

- Maintains a min. pressure (~10bar) in the receiver to:
  - keep the oil flowing.
  - limit pressure drop across the separator.
- Continuous operation at min pressure results in oil carry over due to insufficient scavenge flow.

SEPARATOR ELEMENT

Tip: Don’t remove the earth staple nor use sealant as this could lead to the separator getting electrostatically charged!
The air regulation system continuously adjusts the production of compressed air to the consumption by controlling the engine speed and unloader valve.

- 2 stages: 25/300 25/330

- The unloader valve is pneumatically controlled through the pressure regulator.
- As engine is electronically controlled, units do not have a pneumatic speed control cylinder.
- Engine speed is controlled by the engine ECM. The Wedge controller monitors regulation system pressure and separator tank pressure, measured by pressure transducers, PT2 and PT1. It then computes an engine speed to maintain discharge pressure. This throttle setting is sent to the engine ECM.

RPM: 0
P1: 0 bar
P2: 0 bar

UNIT STOPPED
KEYSWITCH TO START

RPM: 0
P1: 0 bar
P2: 0 bar

KEYSWITCH TO CRANK

RPM: ↑
P1: ↑
P2: ↑

RUN UNLOADED

RPM: Idle
P1: 3.5 bar
P2: ~2 bar
LOAD BUTTON PRESSED, LOADING

RPM: ↑ to 1800 RPM
P1: ↑ to 25 bar
P2: ↓ to 0 bar

RUN, NO AIR CONSUMPTION

RPM: Idle
P1: 25 bar
P2: ~2 bar

RUN WITH AIR CONSUMPTION

RPM: 1800 RPM
P1: 23 bar
P2: 0 bar
**AUTO BLOWDOWN CIRCUIT (2-stages)**

- On 2-stage unloader with the butterfly valve the check valve is located on the discharge. Therefore no pressure can build up during shut down.
- Auto blowdown is done with normally open valve that is kept closed by pilot line during operation.
AUTO BLOWDOWN CIRCUIT (2-stages)

MANUAL BLOWDOWN VALVE

• Can be used as a back-up for the auto blow down valve.
• Must be closed before operation, if not the air regulation system will not work properly.

UNLOADER COMPRESSOR

• Pressurise the unloader valve to close it before starting.
• Stops when glow indicator lights off.
CAPTIVE SOLENOID

- Closed below 1450 RPM.
- Allows to keep the unloader valve closed to reduce load on the engine during start-up.

ORIFICE

- Continuously bleeds air from the regulation circuit.
- If blocked, unloader valve would never be able to open after start up and airend low oil pressure warning would register.
- Size of orifice greatly affects regulation characteristic and should not be adjusted.
- Located near PT2.

WEDGE CONTROLLER

- The WEDGE is located on the rear of the instrument panel.
WEDGE CONTROLLER

- WEDGE Controller is the heart of the machine monitor and control system.
- It is an Intel micro-controller based unit with analog and digital inputs and outputs.
- One of the function is to monitor regulator and discharge pressure, and varies engine speed to maintain air pressure at desired set point.

LOAD SOLENOID

- Situated on back of control panel or near unloader valve.

LOAD BUTTON

- The load button is a momentary action switch.
- It operates the load solenoid adjacent to the pressure regulator.
- Prior to being pressed the solenoid allows the air to by-pass the regulator.
REGULATOR VALVE - OPERATION

• Ball valve actuated by tank pressure and held closed by a spring.
• Controlled pressure preset in factory, can be adjusted by means of adjusting screw.

REGULATOR VALVE

• Situated on back of control panel or near unloader valve.
• Red tape is a resistor that allows defrosting in case of low temperature.

UNLOADER VALVE (two stages)

• Butterfly-type valve, normally open.
• Actuated by a piston cylinder, pressure on piston makes the valve close.
• Check valve situated at airend outlet.
PRESSURE TRANSDUCER, PT1

PRESSURE TRANSDUCER, PT2

ELECTRONIC FUEL SYSTEM

• CAT MEUI Injector
• Solenoid controlled by ECM
ANTI RUMBLE VALVE

- Allows some compressed air from the receiver to return to the inlet at idle.
- This prevents a too great vacuum at the inlet and possible rumble.

INSTRUMENT/CONTROL PANEL

- Interface between user and compressor.
- Provides control, monitoring and diagnostics functions.

INSTRUMENT/CONTROL PANEL

- Discharge pressure gauge
- Panel light
- Hour meter
- Engine Tachometer
- Compressor oil temp. gauge
- 85 - 120 deg C
- Battery voltage
- 23 - 28 v
- Fuel level gauge
- Start switch
- Scroll switch for wedges during running
- Engine water temp. gauge
- 85 - 98 deg C
- Engine oil pressure gauge
- 85 - 120 deg C
**WEDGE CONTROLLER**

- First function of the WEDGE is to scan all analog and digital inputs at a fixed interval. The inputs are scanned every 50 milliseconds. The values are then compared against min. and max. values and an ALERT or SHUTDOWN is issued.
- Second function is to monitor discharge pressure, and varies engine speed to maintain air pressure at desired set point.
- Third function to retrieve diagnostic info from the engine.

**INSTRUMENT/CONTROL PANEL**

1. **HIGH COMPRESSOR TEMP.**
   - Indicates shutdown due to high comp. Temp.

2. **LOW ENGINE OIL PRESSURE.**
   - Indicates shutdown due to low oil P.

3. **HIGH ENGINE COOLANT TEMP.**
   - Indicates shutdown due to high water Temp.

4. **LOW FUEL LEVEL.**
   - Indicates shutdown due to low fuel level.

5. **LOW BATTERY VOLTS.**
   - Indicates battery/charging system needs service.
1. LOW ENGINE COOLANT LEVEL. Alarm indicator lamp. Indicates coolant needs service.
2. RESTRICTED AIR FILTER. Alarm indicator. Indicates eng/comp air filter need service.
3. RESTRICTED ID FILTERS. Shutdown indicator (If equipped) Indicates shutdown due to compressor system fault. Refer to fault code list.
4. COMPRESSOR MALFUNCTION. Engine fault. Refer to engine fault codes.
5. ENGINE MALFUNCTION. Engine fault. Refer to engine fault codes.
6. FAULT CODE & DIAGNOSTICS DISPLAY. Refer to fault code and parameters lists.
DEDICATED LIGHTS

- No code
- Light state table, v1.7

Note: CAN derived data

<table>
<thead>
<tr>
<th>ALERT</th>
<th>SHUTDOWN</th>
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<td>Code</td>
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</table>

WEDGE DISPLAY

- Accessed by toggling:
  - “Service Switch” if machine is stopped
  - “Start” key switch if machine is running
- Number appears first and after three seconds parameter will be displayed.

<table>
<thead>
<tr>
<th>Number</th>
<th>Parameter</th>
<th>Comments</th>
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<tbody>
<tr>
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<td>RPM Filtered</td>
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<td>4</td>
<td>Reg system pressure</td>
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<td>6</td>
<td>Discharge temperature</td>
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<td>Sep tank temperature</td>
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<td>8</td>
<td>Throttle output (Hz)</td>
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<td>11</td>
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<td>17</td>
<td>Boost Pressure</td>
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<tr>
<td>18</td>
<td>Engine Hours</td>
<td></td>
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</tbody>
</table>

WEDGE OPERATION – STARTUP

Power “ON” at Control Panel:
- 1. Key switch signal (24VDC) supplied to engine controller by WEDGE controller
- 2. Frequency throttle signal ON
- 3. Unloader solenoid valve (L2) is closed (de-energized)
- 4. Startup compressor is turned on for 10 seconds.

Engine Start-up:
- When key is switched to the engine crank position:
  - 1. Unloader solenoid valve (L2) is closed (de-energized).
  - 2. Start compressor is turned on.
  - 3. Key switch signal (24VDC) is supplied to engine controller.
  - 4. K1 auxiliary start relay is energized.
  - 5. Run/Start solenoid valve (L1) is opened (energized).

Note: Start compressor remains on, unload solenoid stays open and unloader solenoid valve stays closed for 10 seconds after the key is released if the engine does not start.
- When the engine speed reaches 800 RPM (engine start declared):
  - 1. Engine speed is set to 1500 RPM.
  - When the engine speed reaches 1450 RPM:
    - 1. Unloader solenoid valve is opened (energized) (L2)
    - 2. Start compressor is turned off.
    - 3. Run/Start solenoid valve is closed (de-energized) (L2)
  - When the separator tank pressure reaches 50 psi:
    - 1. Run/Start solenoid valve is opened (energized) (L2)
  - After 5 seconds:
    - 1. Engine speed is set to idle (1200 RPM) if air end discharge temperature is approximately 150 degrees F or (if J1939/CAN is functioning) the engine coolant is 100 degrees F.
    - 2. Start compressor remains on, unload solenoid valve stays closed for 10 seconds after the key is released if the engine does not start.
WEDGE OPERATION – LOADING

Loading:
• When the “Service Air” switch is pushed:
  – 1. Engine speed is set to 1800 RPM
• When engine speed reaches 1700 RPM:
  – 1. Run/Start solenoid valve is closed (de-energized).
• After 2 seconds and if the regulation system pressure is 4 psi or greater:
  – 1. Compressor pressure control is engaged.

• Operation slightly different for two stage machines with butterfly unloader, see Electronic Service Manual.

WEDGE MACHINE ID

FOR WEDGE CONTROL SYSTEMS with V1.60 or Greater Software

• 1. Determine machine ID.
• 2. Turn power to the “ON” position. Machine must not be operating.
• 3. Toggle the switch until number “19” is reached. Push and hold the data input switch and the number “20” will appear. Continue to hold the switch. After 1 second, the current machine ID will appear in the display. Continue to hold for 9 more seconds, the ID selection will blink then release.
• 4. Toggle the data input switch, the display will show “0”. Toggle the data input switch until the proper machine ID appears on the display, then stop the toggle sequence.
• 5. Wait until the controller performs a reset function (approximately 10 seconds). At reset, the controller display will go blank, then all 10 annunciator LED’s light, the 4 digit LED display shows “0000” for a fraction of a second, then displays the installed software version and finally the display goes blank and the engine oil pressure and alternator LED begin flashing. At this point the controller has stored the machine ID selected in Step 4.
• 6. Check the setting.

WEDGE DISPLAY UNITS

• To determine which units the WEDGE has been configured for:
  – 1. With the machine power off (Key turned OFF)
  – 2. Press and hold the “Service Air” Switch
  – 3. Turn the key switch directly to the crank position.
  – 4. Hold these switch positions until the 4 digit LED display on the WEDGE goes blank.
  – 5. Toggle the data input switch, the display will show “0”. Toggle the data input switch until the proper setting appears on the display.
  – 6. Units will be displayed for 2 seconds as:
    • PSI for Deg F, PSI
    • Bar for Deg C, Bars
    • kN/c for Deg C, Kg/cm2
    • HPA for Deg C, KPa

• To change the units setting:
  – 1. With the WEDGE showing the current setting, press and release the “Service Air” switch until the desired setting appears on the display.
  – 2. Once it appears, do not release the “Service Air” switch. Hold it in the ON position until the WEDGE restarts. This will select units selection that was displayed.
  – 3. Release the “Service Air” switch. The compressor is ready to start.
PDA SERVICE TOOL

- Plugs on connector near wedge controller.
- Features:
  - Extract shut down / alarm history
  - Read controller fault codes
  - Read/capture SAE J1939 engine data
  - Download controller software

ELECTRICAL WIRING

- System Diagram
- General Machine Wiring Schematic
- Control Panel Wiring Schematic
MACHINE WIRING HARNESS

- Links the wedge controller to:
  - The engine controller
  - The compressor sensors
  - The actuators
  - The control panel
  - But NOT the engine sensors

- The engine sensors are linked to the engine controller via the engine harness.

CONNECTOR P1 - WEDGE

CONNECTOR P2 - ECM
The WEDGE connects to the startup compressor through relay K2. The startup compressor is activated at engine crank to provide air to close the inlet valve to the airend.

Troubleshooting:
- The start compressor activate signal is turned on at engine crank for 10 seconds. At all other times it is off.
- First ensure the protection fuse is not blown.
- Then verify the control signal from the WEDGE to the K2 relay is activated at engine crank. This can be measured at P1-29 at the WEDGE or at pin 2 (85) on K2 relay.
CAN TERMINATORS R4, R6

SWITCHES S10, S11 – AIR FILTER RESTRICTION

MAGNETIC SENSOR G2 – ENGINE SPEED
TEMP. SENSORS RT2, RT3 - DISCHARGE TEMP.

RT3 to Control Panel Gauge
RT2 to Wedge