Doosan Infracore

COMPRESSOR TRAINING

EMU Range

Doosan Infracore Portable Power

Ingersoll Rand Construction Technologies

PRODUCT RANGE

- 9/270 – HP915 - 8.6bar (125psi), 27m3/min (950cfm)
- 9/300 – XP1000 - 8.6bar (125psi), 30m3/min (1060cfm)
- 12/235 – VHP825 - 12bar (175psi), 23m3/min (825cfm)
- 17/235 - 17bar (250psi), 23m3/min (825cfm)
- 21/215 - XHP750 - 21bar (300psi), 21.5m3/min (760cfm)

PRODUCT RANGE

- High ambient units (non CE) will now use the new nomenclature
  - E.G. no longer use VHP825, now 12/235
- Additional decal will distinguish between CE and non-CE units
  - CE for CE units
  - HA for non-CE units

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 TIER II

- 6IRQ9AE – Cummins QSL9
- 6 cylinders
- 8.9L displacement
- Power ratings @ 1800 RPM:
  - 224kW (300hp) - 9/270 & 12/235
  - 255kW (340hp) - 9/300, 17/235 & 21/215
- Turbocharged and after-cooled
- CAPS electronic injection pump
- Tier II certified
- 24 Volt Electrics

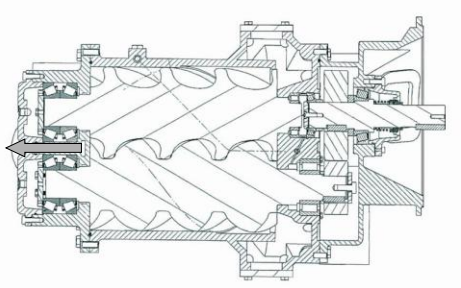
ENGINE TIER III

- 6IRQ9AE – Cummins QSL9
- 6 cylinders
- 8.9L displacement
- Power ratings @ 1800 RPM:
  - 224kW (300hp) - 9/270 & 12/235
  - 255kW (340hp) - 9/300, 17/235 & 21/215
- Turbocharged and after-cooled
- Common rail electronic
- Tier III certified
- 24 Volt Electrics

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 EMU range:
  - Single stage on 9/270, 9/300, 12/235
  - Two stages on 17/235, 21/215

WW 226mm AIREND

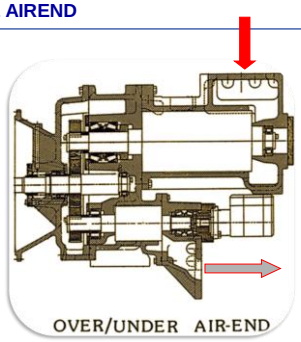


9/270, 9/300, 12/235

WW 226mm AIREND

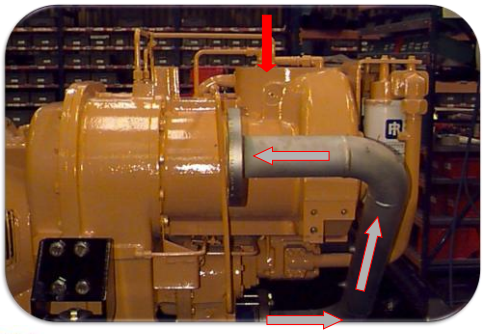
HR2 HIGH PRESSURE AIREND

- 2-stage airend
- Oil pump driven by second stage

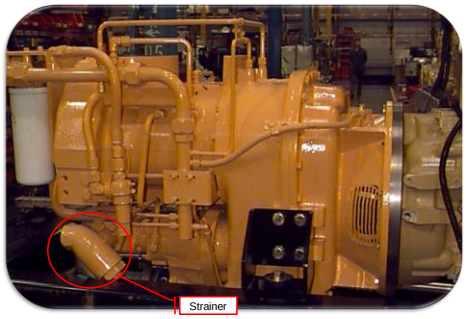


17/235, 21/215

HR2 HIGH PRESSURE AIREND



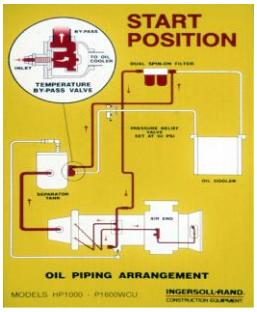
HR2 HIGH PRESSURE AIREND

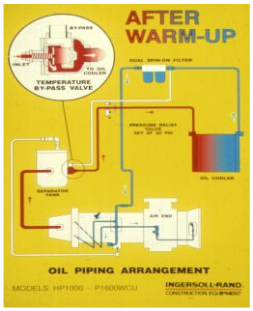


COMPRESSOR OIL SYSTEM

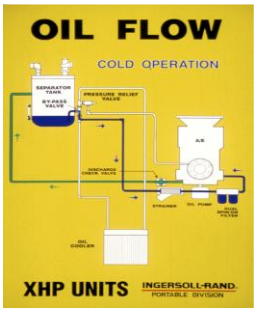
- Functions of the oil system:
  - Lubricating the rotors, airend bearings and mechanical seals
  - Sealing the clearances between the airend rotors
  - Cooling of the airend. Heat is generated during air compression.
- The oil flows due to the air pressure. Only the two-stage airend uses an oil pump.

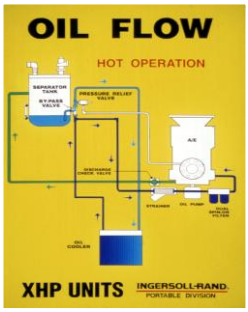
COMPRESSOR OIL SYSTEM





COMPRESSOR OIL SYSTEM





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.

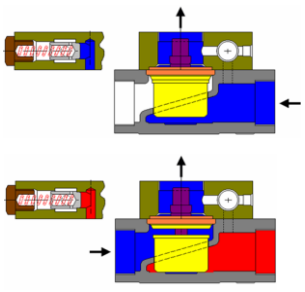
OIL TEMP. BYPASS VALVE

- 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

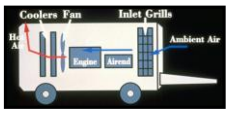


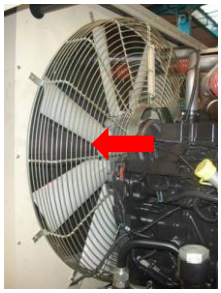
COOLER PACKAGE

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!





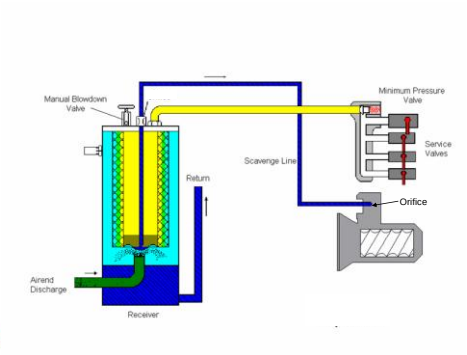
OIL FILTERS

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

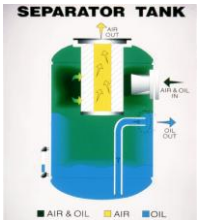
SEPARATION SYSTEM

- 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



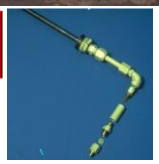
SEPARATOR/RECEIVER TANK



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



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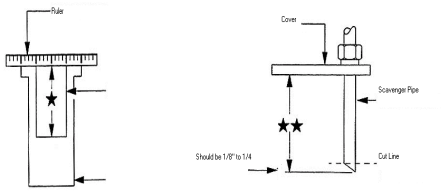


Tip: Always check scavenge tube length when replacing separator element

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.

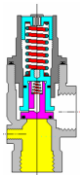
Tip: Look for clogged scavenge lines in case of oil carry over!

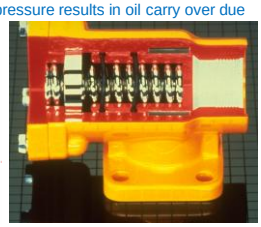
SAFETY VALVE

- Valve is on the oil side of the element where pressure is maximum when the separator element is blocked.

MINIMUM PRESSURE VALVE

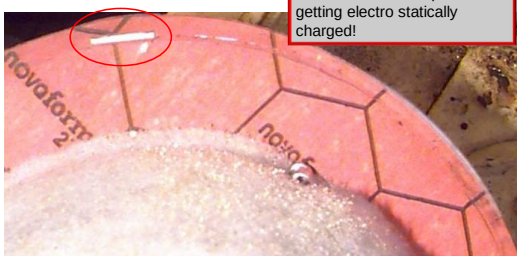
- Maintains a min. pressure (~5bar) in the receiver to:
  - keep the oil flowing.
  - limit pressure drop across the separator.
- Continuous operation at min pressure results in oil carry over due to insufficient scavenge flow.





SEPARATOR ELEMENT

Tip: Don't remove the earth staple nor use sealant as this could lead to the separator getting electro statically charged!



AIR REGULATION SYSTEM

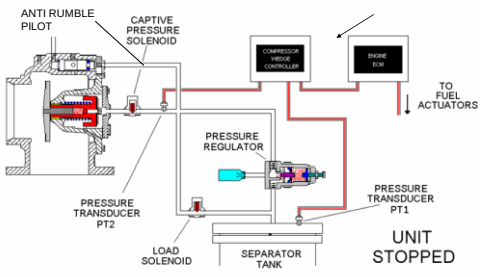
- The air regulation system continuously adjusts the production of compressed air to the consumption by controlling the engine speed and unloader valve.

- The blow down system allows to relieve the pressure from the separator tank automatically or manually if required.

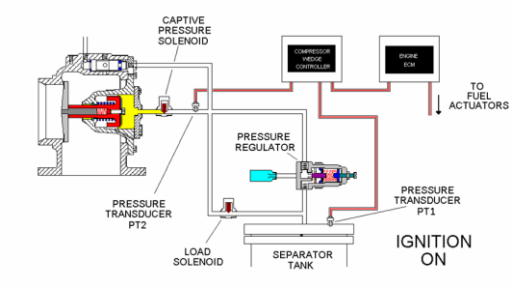
AIR REGULATION SYSTEM

- The unloader 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.

REGULATION SCHEMATIC



REGULATION SCHEMATIC



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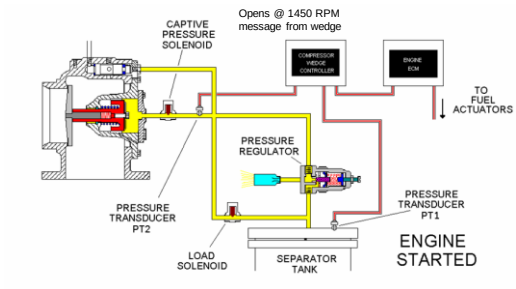

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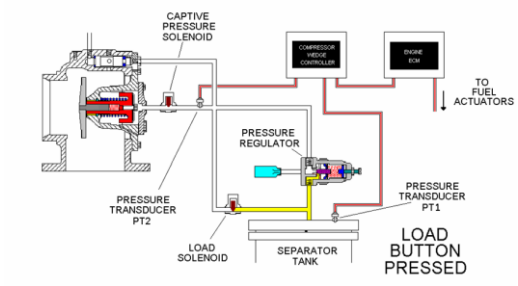
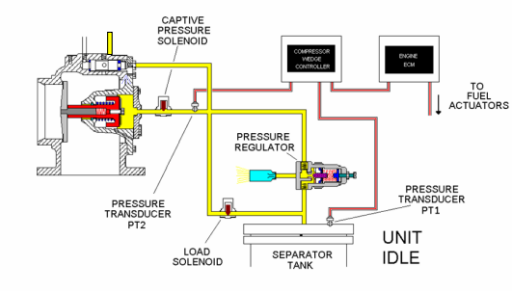
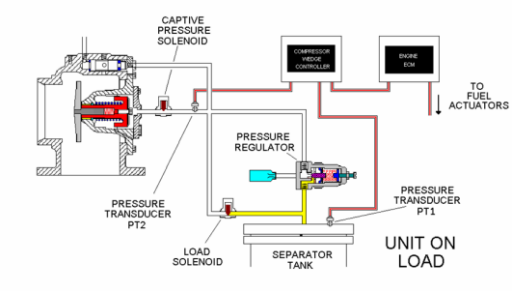


REGULATION SCHEMATIC



REGULATION SCHEMATIC



UNLOADER COMPRESSOR

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

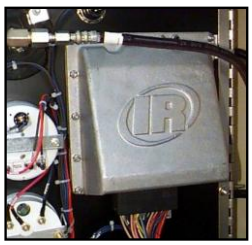
CAPTIVE SOLENOID

- 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

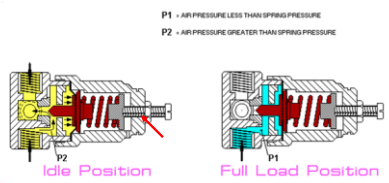
- Situated on back of control panel or near unloader valve.

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

- Needle valve actuated by diaphragm and held closed by a spring.
- Controlled pressure preset in factory, can be adjusted by means of adjusting screw.
- Pin hole allows to determine diaphragm condition.



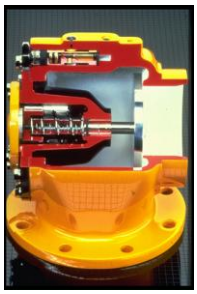
REGULATOR VALVE

- 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 (one stage)

- Valve actuated by piston with diaphragm.
- Spring keeps valve normally opened, pressure on piston makes the valve close.
- Also acts as check valve to avoid oil going to filters during shut down.

Tip: Pin hole allows to determine if diaphragm has failed!

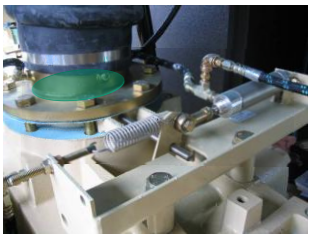


UNLOADER VALVE (one stage)

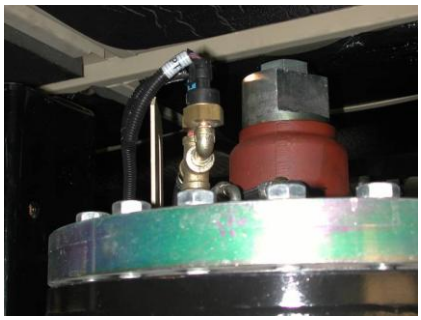
UNLOADER VALVE (two stages)

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

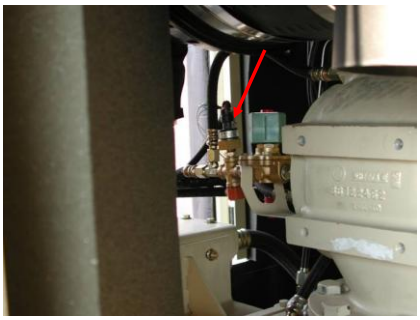
UNLOADER VALVE (two stages)



PRESSURE TRANSDUCER, PT1



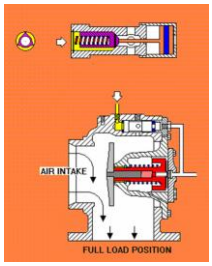
PRESSURE TRANSDUCER, PT2

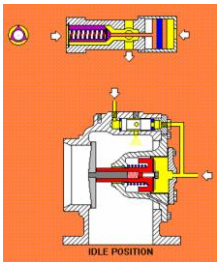


ANTI RUMBLE VALVE

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

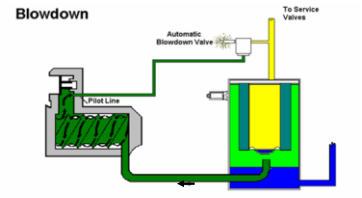
ANTI RUMBLE VALVE - OPERATION





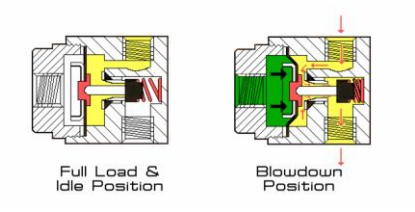
AUTO BLOWDOWN CIRCUIT (one stage)

- Normally closed valve.
- Pilot is high pressure at inlet that appears when compressor is stops and unloader check valve closes.

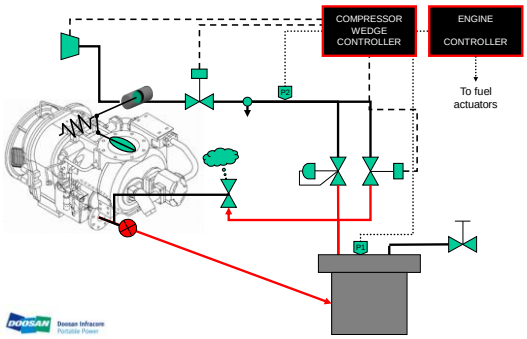


AUTO BLOWDOWN VALVE

AUTO BLOWDOWN VALVE

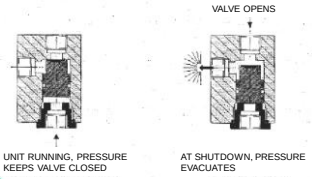


AUTO BLOWDOWN CIRCUIT (2-stages)



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.



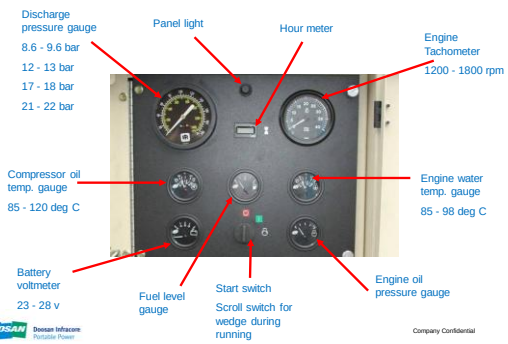
MANUAL BLOWDOWN VALVE

- 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.

INSTRUMENT/CONTROL PANEL

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

INSTRUMENT/CONTROL PANEL



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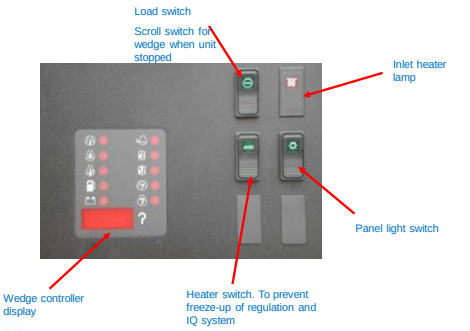


WEDGE CONTROLLER

- 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.

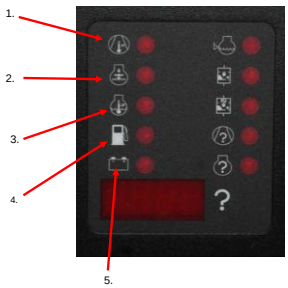
Indicates shutdown due to high water Temp.

4. LOW FUEL LEVEL.

Indicates shutdown due to low fuel level.

5. LOW BATTERY VOLTS.

Indicates battery/charging system needs service.



INSTRUMENT/CONTROL PANEL

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 IQ FILTERS.

Shutdown indicator (If equipped)

4. COMPRESSOR MALFUNCTION.

Indicates shutdown due to compressor system fault. Refer to fault code list.

5. ENGINE MALFUNCTION.

Engine fault. Refer to engine fault codes.

6. FAULT CODE & DIAGNOSTICS DISPLAY.

Refer to fault code and parameters lists.

CPRSR MALFUNCTION LIGHT

- 2-digits codes
- Extract of wedge fault code reference table v1.7

	ALERT			SHUTDOWN			
	CODE	LIGHT (BLINKS)	Machine ID	CODE	LIGHT (STEADY)	DELAY (sec)	Machine ID
Engine Speed < Min. RPM				1	CPRSR Malf	30	All[3]
Engine Speed > Max. RPM				2	CPRSR Malf	30	All[4]
Engine Crank Time Exceeded				3	CPRSR Malf	0	All[1]
Engine Oil Temperature > 252 deg. F	5	CPRSR Malf.	0–6				
Intake Manifold Temperature > 180 deg. F	6	CPRSR Malf.	0–7				
Water In Fuel	8	CPRSR Malf.	5,6				
Engine Not Responding to Throttle Cmd.	10	CPRSR Malf.	All				
Too Many Start Attempts during Autostart				11	CPRSR Malf	0	All

Note: CAN derived data

ENGINE MALFUNCTION LIGHT

- 3,4-digits codes
- Extract of Cummins engine fault code reference table

Displayed	Code Definition
111	Engine Control Module – Critical Internal Failure
115	Engine Speed/Position Sensor Circuit – Lost Both of Two Signals
122	Intake Manifold Pressure Sensor Circuit – Voltage Above Normal, or Shorted High
123	Intake Manifold Pressure Sensor Circuit – Voltage Below Normal, or Shorted Low
135	Engine Oil Pressure Sensor Circuit – Voltage Above Normal, or Shorted High
141	Engine Oil Pressure Sensor Circuit – Voltage Below Normal, or Shorted Low
143	Engine Oil Pressure Low – Warning
144	Engine Coolant Temperature Sensor Circuit – Voltage Above Normal, or Shorted High
145	Engine Coolant Temperature Sensor Circuit – Voltage Below Normal, or Shorted Low

DEDICATED LIGHTS

- No code
- Light state table, v1.7

Note: CAN derived data

	ALERT			SHUTDOWN			
	CODE	LIGHT (BLINKS)	Machine ID	CODE	LIGHT (STEADY)	DELAY (sec)	Machine ID
Low Fuel Level		Fuel Level	0-6		Fuel Level	3	All
Air Filter Restriction		Soiled Filter	All				
Low Battery Voltage		Battery Charging Condition	All				
Engine Oil Pressure < 16 PSI		Low Engine Oil Pressure	All				
Low Coolant Level		Engine Coolant Level	0,1,5, 6				
Engine Coolant Temp > = 215 deg. F		High Engine Temp	All				
Engine Coolant Temp > = 220 deg. F.					High Engine Temp	10	All
IQ Filter Restriction					IQ Filter Re-striction	3	0-6
High Discharge Temp. (RT2 > 247 deg. F)					High Comp. Temp.	3	All

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.

Number	Parameter	Comments
2	RPM	F/W sensor
3	RPM Filtered	
4	Reg system pressure	
5	Sep tank pressure	
6	Discharge temperature	
7	Sep tank temperature	
8	Throttle output	(Hz)
9	Machine type	**
10	Engine coolant temp	from CAN
11	Engine oil temp	from CAN
12	Engine oil pressure	from CAN
13	Intake Manifold temp	from CAN
14	RPM	from CAN
15	Fault code list	Engine code
16	Throttle Position	
17	Boost Pressure	
18	Engine Hours	
19	Load @ Speed	

** 1 = CU XHP Viking, 2 = CAT EMU LP, 3 = CAT EMU HP, 4 = XHP CAT Viking, 5 = CU EMU LP, 6 = CU EMU HP, 7 = P426 Deere, 8 = WW600

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. Start-up compressor is turned on for 10 seconds

Engine Start-up:

- When the 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, run/start 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 600 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 J1939CANis functioning). The engine coolant is 100 degrees F. Othrwise, the engine idle stays at 1500 RPM.

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 and a blinking "--" will appear. Release the switch.
- 5. 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.
- 6. Wait until the controller performs a reset function (approximately 10 seconds). At reset, the controller display first goes blank, then all 10 annunciator LED's light, the 4-digit LED display shows all 8's, the display then shows 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 5.
- 7. Check the setting.

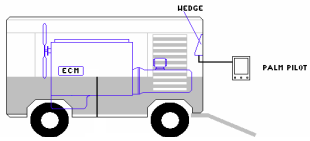
WEDGE DISPLAY UNITS

- 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. Release "Service Air" switch, release key switch to "ON".
  - 6. Units will be displayed for 2 seconds as:
    - 'PSI' for Deg F, PSI
    - 'Bar' for Deg C, Bars
    - 'H9C' for Deg C, Kg/cm2
    - 'HPA' for Deg C, KPa

- To change the units setting:
  - 1. With theWEDGEshowing 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.

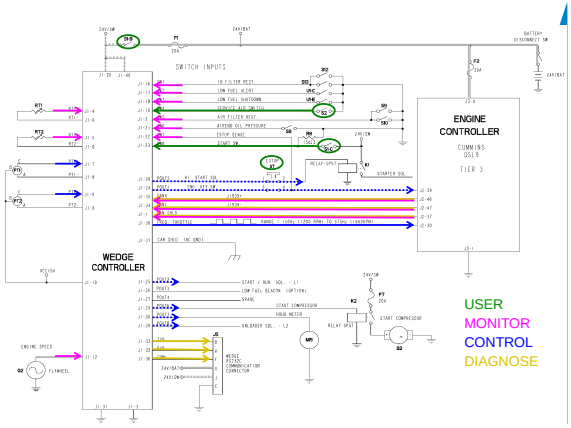
PDA SERVICE TOOL

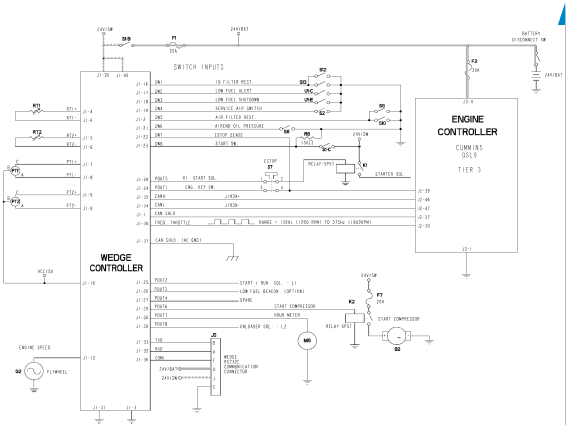
- Plugs on connector near wedge controller.
- Features:
  - Extract shut down / alarm history
  - Read controller fault codes
  - Read/capture SAE J1939 engine data
  - Download controller software



ELECTRICAL WIRING

- System Diagram
- General Machine Wiring Schematic
- Control Panel Wiring Schematic



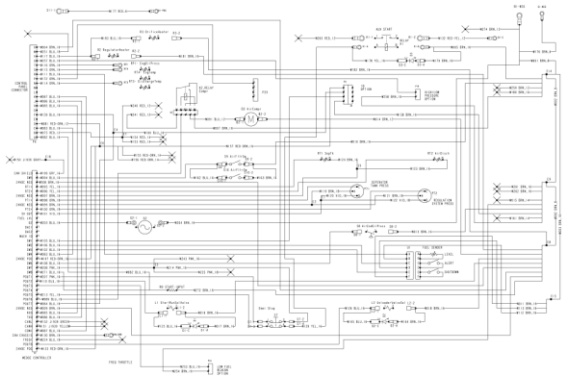


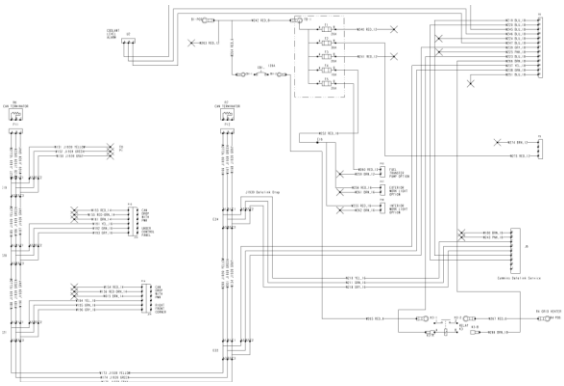
K – STARTUP AIR COMPRESSOR

- 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.

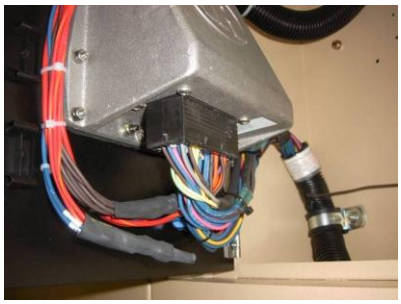
MACHINE WIRING HARNESS

- 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 link to the **engine** controller via the **engine** harness.



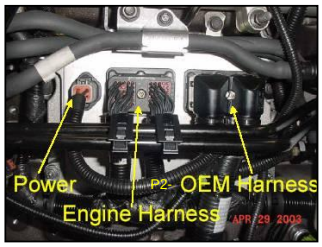


CONNECTOR P1 -WEDGE



CONNECTOR P4 - CONT. PANEL

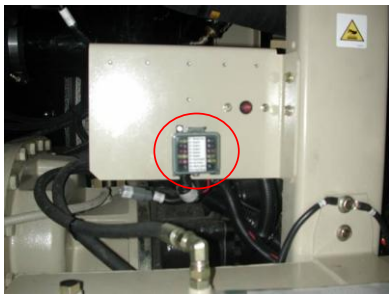
CONNECTOR P2 - ECM



CONNECTOR J6 – CUMMINS DATALINK

CONNECTOR R5 – WATER SENSOR

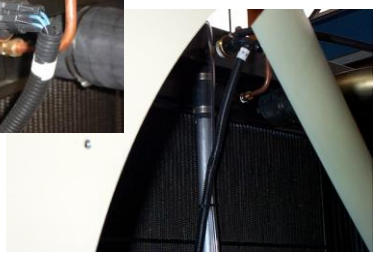
FUSE BOX LOCATION



LOAD SOLENOID

CONNECTOR B2 – UNLOADER COMPRESSOR

CONNECTOR U2 - RAD LEVEL SW



FUEL LEVEL SENDER

RT3 - DISCHARGE TEMP. SENDER

SWITCH S8 - OIL PRESSURE

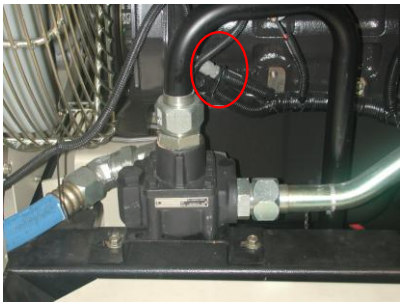
WEDGE ID RESISTOR R1 (OBSOLETE)

Machine ID Resistor 'R1'

Resistor Menu

Machine ID Code	Machine Type	Resistor Colour
0	Viking HP CU	Green
1	Viking XHP CU	Blue
2	Emu LP CAT	Yellow
3	Emu HP CAT	Red
4	Viking XHP CAT	Black
5	Emu LP CU	Purple
6	Emu HP CU	Orange
7	Zenith P425	Grey
8	WW600	White

R7 - CAN TERMINATOR



Maintenance General

- Fuel Quality → SULFUR content
  - Recommended Sulfur content is less than 0.10% (1000ppm).
  - If Sulfur is between 0.10 and 0.50 % we strongly suggest decreasing oil maintenance intervals based on oil sampling data.

- Fuel Quality → Solid contaminants
  - Fuel used should meet EN590 or ASTM D975 specification
  - Dirty fuel will damage vital fuel system components , causing machine downtime and expensive repairs.
  - If Biofuel is used it should be conform to JD specs. (consult engine manual)

Options

- Aftercooler W/ Waterseparator
- IQ system
- Low Fuel Shutdown (beacon)
- Spark Arrestor
- Overspeed valve
- Work lights
- Service Lights
- Dual Pressure
- Auto Start/Stop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Portable Power


IR
Ingersoll Rand
Construction Technologies