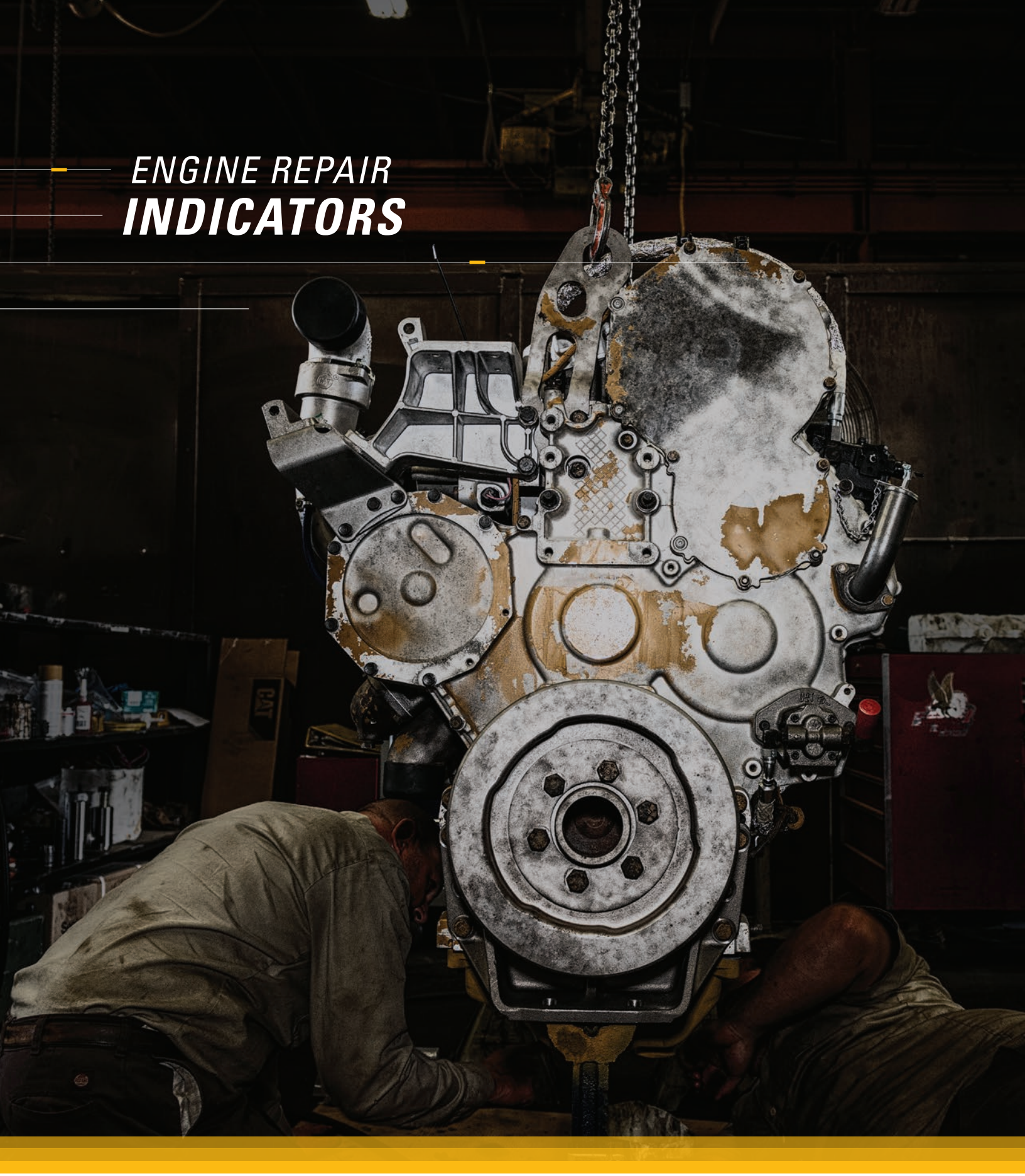


ENGINE REPAIR
INDICATORS

90% OF FAILURES ARE PREVENTABLE

UNDERSTAND ENGINE INDICATORS FOR PEAK PERFORMANCE

REGULAR MAINTENANCE INTERVALS AND PROPER INSPECTIONS ARE CRITICAL TO PREDICTING THE RIGHT TIME FOR A REPAIR. THERE ARE BOTH **PLANNED** AND **PROBLEM INDICATORS** THAT MAY BE CAUSING A LOSS IN PRODUCTIVITY AND RESULTING IN A HIGHER COST.

PLANNED INDICATORS

THERE ARE A VARIETY OF PLANNED INDICATORS THAT CAN HELP YOU PROTECT YOUR ENGINE AND AVOID A LOSS IN PRODUCTIVITY AND HIGHER COSTS.

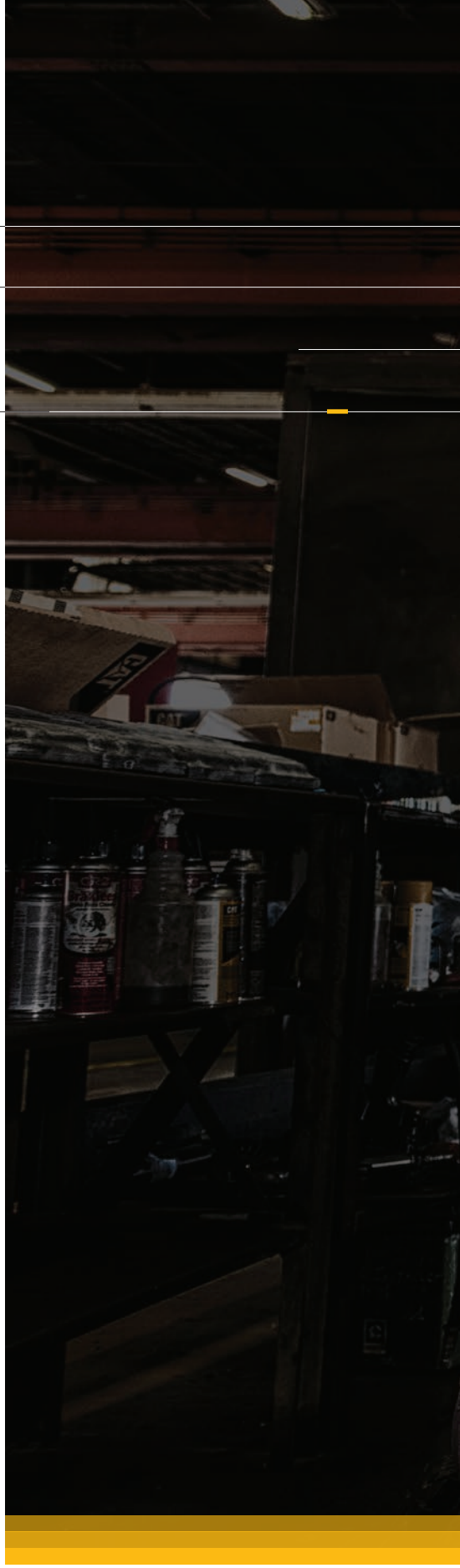
Planned Indicator	Description
S•O•S℠ Services	S·O·S Services provide the best insight into internal component wear and potential failure.
Service Meter Hours	Operating and Maintenance Manual gives general guidelines for servicing based on service meter hours.
Service History	Service history indicates how frequently routine maintenance is performed.
Fuel Consumption	Fuel consumption indicates when a piece of equipment on your truck is operating at less than optimum efficiency.

PROBLEM INDICATORS

THERE IS A WIDE RANGE OF PROBLEM INDICATORS THAT CAN ALERT YOU TO ENGINE PROBLEMS AND THEIR CAUSES BEFORE THEY TURN INTO COSTLY REPAIRS.

Problem Indicator	Possible Causes
EXCESS BLACK SMOKE AT FULL LOAD (hot, unburned fuel)	» Dirty primary/secondary air cleaner » Operating in too high a gear » Overfueling » Overloading
INCREASED FUEL CONSUMPTION	» Malfunctioning fuel nozzles/injectors » Malfunctioning turbocharger » Dirty air cleaner » Improper set point » Fuel leak
BLUE SMOKE (oil consumption)	» Worn turbocharger seals » Worn rings/liners » Worn valve guides » Hours on engine
WHITE SMOKE (steam: water in combustion chamber)	» Cracked head and/or liners » Leaking head gasket
WHITE SMOKE (on start-up: unburned fuel)	» Incorrect starting procedure » Incorrect fuel injector timing » Faulty injector
INCREASED OIL CONSUMPTION (excess blow-by)	» Worn or broken rings/liners » Worn turbocharger seals » Worn valve guides » Hours on engine
UNUSUAL NOISES	» Malfunctioning fuel nozzles/injectors » Malfunctioning turbocharger » Worn piston pin bushings » Worn rod/main bearings » Too much valve lash
LACK OF POWER	» Incorrect adjustment of governor linkage » Malfunctioning fuel nozzles/injectors » Slipping torque converter » Improper set point » Dirty fuel filter » Dirty air cleaner » Low-quality fuel
OVERHEATING	» Malfunctioning temperature regulator » Incorrect adjustment or worn belts/pulleys » Incorrect operator technique » Plugged radiator core (external and internal) » Low coolant level » Dirty air cleaner
HARD STARTING (engine missing)	» Malfunctioning fuel nozzles/injectors » Improper starting technique » Worn fuel injector pump » Low cranking speed » Low-quality fuel (low cetane rating or water in fuel)
OIL LEVEL OVER FULL	» Coolant/fuel leak into crankcase » Improper oil fills
DEBRIS IN OIL FILTER	» Coolant/fuel leakage into crankcase » Extended oil change period » Damaged bearings » Wrong oil used » Dirt entry

Options	S•O•S℠ Indicator	Possible Causes
» Faulty Turbocharger » Technical Analysis Inspection » Customer/Dealer Discussion	Soot, Fe, Cr, Al	» Dirty air filter » Piston rings » Liners
» Technical Analysis Inspection » Customer/Dealer Discussion » Tune-up	Positive fuel contamination, decreased viscosity	» Fuel leaking into oil from injectors » Shearing of the oil additives
» S•O•S Fluid Analysis » Component Inspection/Repair » Repair Determination Inspection » Customer/Dealer Discussion	Fe, Cr	» Broken or stuck piston rings » Ether start-up » Running too cold or hot » Oil jet broken
» Technical Analysis Inspection	Positive coolant contamination, Na, K, Si, Cu	» Coolant entry
» Customer/Dealer Discussion » Tune-up	Positive fuel contamination, decreased viscosity	» Fuel leaking into oil from injectors » Shearing of the oil additives
» S•O•S Fluid Analysis » Component Inspection/Repair » Repair Determination Inspection » Technical Analysis Inspection » Customer/Dealer Discussion	Fe, Cr	» Broken or stuck piston rings » Ether start-up » Running too cold or hot » Oil jet broken
» Technical Analysis Inspection » Repair Determination Discussion » Customer/Dealer Discussion » Tune-up » Component Inspection Repair	Positive fuel contamination, decreased viscosity, Cu, Pb, Al	» Fuel leaking into oil from injectors » Shearing of the oil additives » Rod eye bushing » Piston pin bushing » Lower rod bearings
» Technical Analysis Inspection » Customer/Dealer Discussion » Tune-up	Soot, Fe, Cr	» Dirty air filter » Low-quality fuel » Piston rings and liners
» Technical Analysis Inspection » Customer/Dealer Discussion » Cooling System Maintenance	Oxidation increases, Fe, Pb, Al, Cu, soot	» Liner » Gears » Valve train wear
» Customer/Dealer Discussion » Tune-up	Soot, Fe, Cr	» Dirty air filter » Low-quality fuel » Piston rings and liners
» S•O•S Fluid Analysis » Customer/Dealer Discussion	Positive coolant contamination, Na, K, Si, Cu	» Coolant entry
» S•O•S Fluid Analysis » Customer/Dealer Discussion	Positive coolant contamination, positive fuel contamination, oxidation increases, Si, Al	» Coolant entry » Fuel leaking into oil from injectors » Overheating » Dirt contamination



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