MIT's/EBS's Preliminary Infringement C

MIT/EBS v. Ford, No. 19

Exhib

U.S. Patent No. 8,069,83

The following claim charts include illustrations, photographs, and references relating to Ford Engines u EcoBoost Engine; Second Generation 2.7L and 3.5L EcoBoost Engines; 3.5L High Output Second Generation "Accused Instrumentalities," or "Accused Engines"). The preliminary infringement contentions set forth in th Disclosure of Asserted Claims and Infringement Contentions, as well as all models and revisions identified by D understood as a non-limiting example of how Plaintiffs allege that all accused products set forth for that claim—c

'839 Patent Claim Element	**Preliminary Infringement Theory**
1[a]. A spark ignition engine that is fueled both by direct injection and by port injection	The Accused Products include a spark ignition engine that is fueled both by direct injectio The Accused Products include turbocharged and/or naturally aspirated spark-ignition engi direct fuel injection (DI), which Ford refers to as, among other things, the "Ford port-fuel combining both PI and DI benefits, using each to diminish the other's negatives."); *id.* [E injection (DI) and lower-pressure port injection (PI). Applications include turbocharged a one [of such DI system] is atomizing the liquid to fine droplets, achieved by forcing gasol 6 [has] two fuel injection systems: direct injection and port fuel injection."); Ex. 10 [EBS include the Ford port-fuel and direct-injection (PFDI) system with two injectors per cylin turbos for on-demand power with virtually no lag."); Ex. 15 [EBS-00003169, at 171] ("P Ex. 4 [EBS-00003074, at 077] ("Under the unique Raptor hood is the 24-valve, 3.5L twin ("The 3.3L Ti-VCT V6 delivers responsive performance with 290 horsepower and 265 lb to suit operating conditions, so power output is optimized at every point across the perfor cylinder — one mounted in the air intake port, another inside the cylinder."); *id.* [EBS-00 injection (PFDI) system with two injectors per cylinder — one in the air intake port, anoth aspirated 5.0-Liter Coyote V8 in the 2018 Ford Mustang . . . now combines low-pressure crankshaft and connecting rod bearings."); Ex. 3 [EBS-00002946, at 948] ("With advance 25 lb.-ft. increase in torque, and at lower engine speeds compared to a traditional V8. Lik segment-exclusive 10-speed automatic transmission for 2018."); Ex. 10 [EBS-00003074, Engineer it with the Ford port-fuel and direct-injection (PFDI) system with two injectors injection technology [for the 1.5L Dragon EcoBoost] helps deliver high power and respon loads.").
[1b] wherein above a selected torque value the ratio of fuel that is directly injected to fuel that is port injected increases;	Above a selected torque value the ratio of fuel that is directly injected to fuel that is port i The Accused Products include a fuel management system, which Ford identifies as, amon (PFI) and direct fuel injection (DI). *E.g.*, Ex. 10 [EBS-00003074, at 075]; *see also, e.g.*, rpm and load increase, fuel delivery becomes a programmed blend of PI and DI." Ex. 1 [E Further, laboratory testing performed by the National Highway Traffic Safety Administra below 40 percent. The DI system is quickly blended in above 40 percent absolute engine l the DI system. At absolute engine loads above 140 percent the PFI system provides an inc fuel is provided by the DI system and 40 percent by the PFI system that corresponds to th

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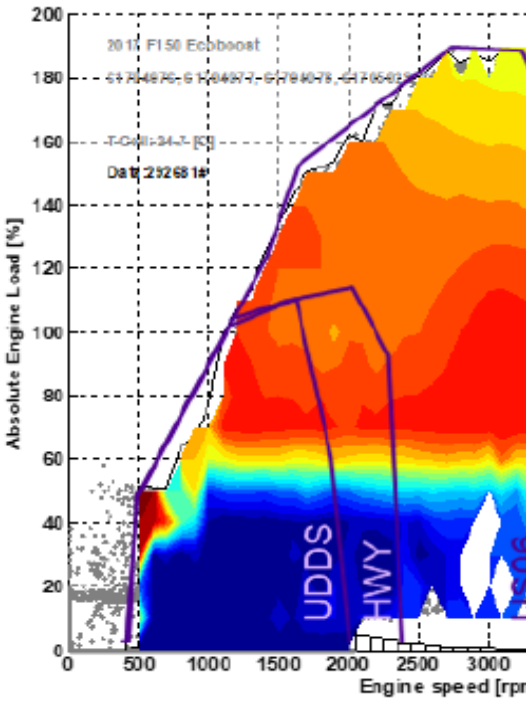
	5.4.3.2.DI vs PFI The fuel can be fed to the engine through the PFI map of the PFI and DI strategy. The PFI system p lute engine load is below 40 percent. The DI syst lute engine load. Between 60 percent to 140 perce the fuel is delivered through the DI system. At ab system provides an increase proportion of the fue load above 2,000 rpm 60 percent of the fuel is pro PFI system that corresponds to the values shown  *Figure 29: DI and PFI usage map as a function of the engine speed* The island of 100 percent DI operation at 575 rpm the engine starting on the DI system before switch ous section. Ex. 9 [EBS-00002974, at 026].
	Further, it has been reported that Ford's use of PFI "allows engineers to shut down the dir emissions." Ex. 16 [EBS-00003177, at 180]. And it has been reported that the ratio of dir that only "5 to 10 percent of the fuel delivery" is provided via port injection. Ex. 1 [EBS-
[1c] and wherein the engine is operated at a	The engine may be operated at a substantially stoichiometric fuel/air ratio.

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substantially stoichiometric fuel/air ratio.	As noted above, the Accused Instrumentalities include a fuel management system, which both port fuel injection (PFI) and direct fuel injection (DI). Ex. 10 [EBS-00003074, at 07 Ford vehicles equipped with the Accused Instrumentalities utilize what are known in the operating at a stoichiometric fuel/air ratio. *See, e.g.*, Ex. 8 [EBS-00002969, at 971] ("In composition at stoichiometric."); *see also, e.g.*, Ex. 12 [EBS-00003091, at 123] (providin As shown below, the laboratory testing performed by the National Highway Traffic Safet substantially stoichiometric fuel/air ratio, where Lambda ≅ 1.

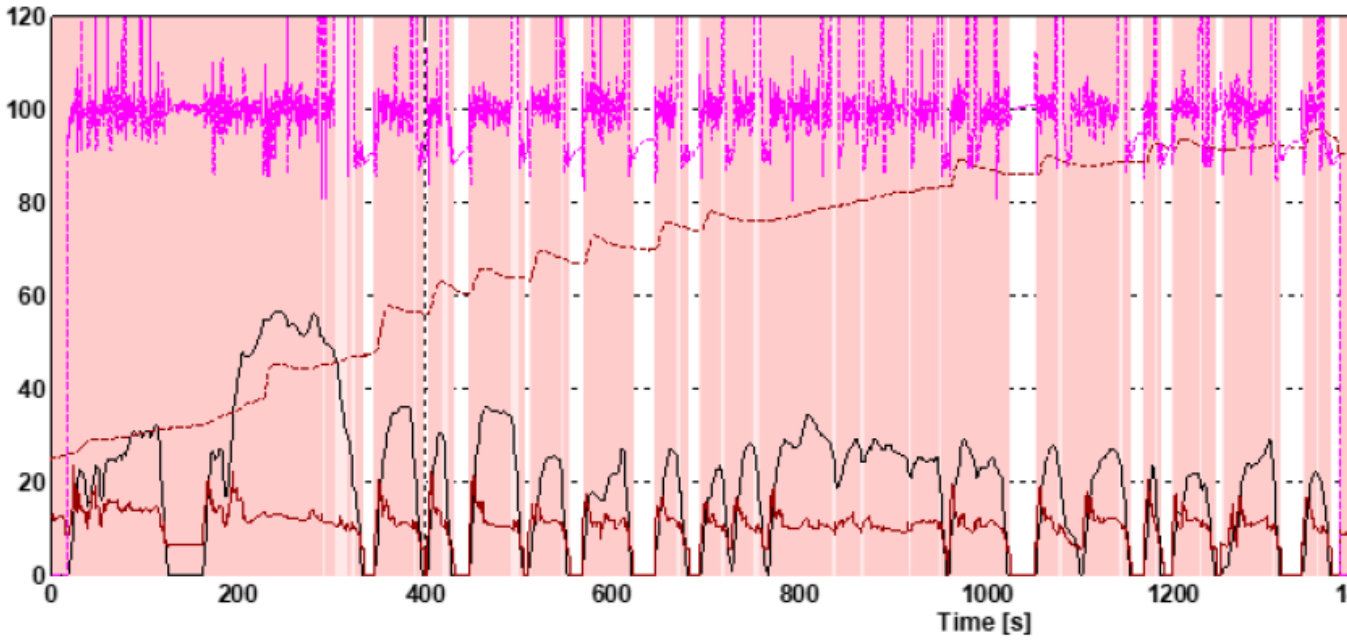

Figure 21: Engine start stop behavior on cold start UDDS

Ex. 9 [EBS-00002974, at 018].

2. The spark ignition engine of claim 1 where the ratio of directly injected fuel to port injected fuel increases with increasing torque.	*See* Claim 1. The ratio of directly injected fuel to port injected fuel increases with increasing torque. The Accused Instrumentalities include a fuel management system, which Ford identifies injection (PFI) and direct fuel injection (DI). Ex. 10 [EBS-00003074, at 075]; *see also* Ex that, "[a]s rpm and load increase, fuel delivery becomes a programmed blend of PI and D Laboratory testing performed by the National Highway Traffic Safety Administration con 40 percent. The DI system is quickly blended in above 40 percent absolute engine load. E system." Ex. 9 [EBS-00002974, at 026].

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	It has been reported that Ford's use of PFI "allows engineers to shut down the direct-injec emissions." Ex. 16 [EBS-00003177, at 180]. It also has been reported that the ratio of directly injected fuel to port injected fuel can eve is provided via port injection. Ex. 1 [EBS-00002931, at 938].
3. The spark ignition engine of claim 2 where the ratio of directly injected fuel to port injected fuel is determined by a signal from a knock detector.	The ratio of directly injected fuel to port injected fuel is determined by a signal from a kno *See* Claim 2. For example, Ford utilizes sensor(s) that detect knock. *See, e.g.*, Ex. 6 [EBS-00002962, at learns your fuel quality while you drive. All the EB engines we work with use this adap noise and are mounted to the engine block. If the engine noise falls within the correct frequ added)); Ex. 11 [EBS-00003085, at 87] ("The naturally aspirated 5.0-Liter Coyote V8 in model year. The cylinders have been bored out to 93.0 mm, up from 92.2 mm. The V8 n more powerful than before, providing up to a peak 460 horsepower and 420 pounds-feet of Knock is a significant issue at moderate-to-high loads (also known as torques). In general used most of the time). As a result, the engine can create more low-speed torque through premature ignition of the fuel and air mixture—is diminished because the phase-change co surface temperatures ***enables a higher compression ratio and improved efficiency*** whetl combining the new dual-injection strategy with higher boost pressure."); Ex. 3 [EBS-0000 EcoBoost engine delivers a 25 lb.-ft. ***increase in torque, and at lower engine speeds*** com *See, e.g.*, Ex. 1 [EBS-00002931, at 36] ("With ***DI***, the chance of detonation—premature ig compression stroke just before ignition. Lowering the combustion chambers' surface temp or boosted. Ford raised peak torque by 30 lb-ft in its new 3.5-liter V-6 by combining the Powertrain's well-travelled chief engineer, told Automotive Engineering the cost of movi ***the designs permit—largely because of the higher compression ratios (CR) available fro*** octane unleaded. ***At lower loads, "the DI system bleeds off,"*** Dowding said, and PFI take Thus, it can be inferred that the ratio of directly injected fuel to port injected fuel is determ and at low rpm for smooth, quiet, and efficient engine operation. As rpm and load increas Knock Response table pictured below. Based on the intensity of the knock, the fuel manag "[t]he more intense the knock, the more timing will be pulled." Ex. 6 [EBS-00002962, at the quality of your fuel over time. The learning variable is called OAR (Octane Adjust Ra react. If knock is detected, if setup correctly, the system will very quickly pull timing to s

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Ex. 6 [EBS-00002962, at 963].

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