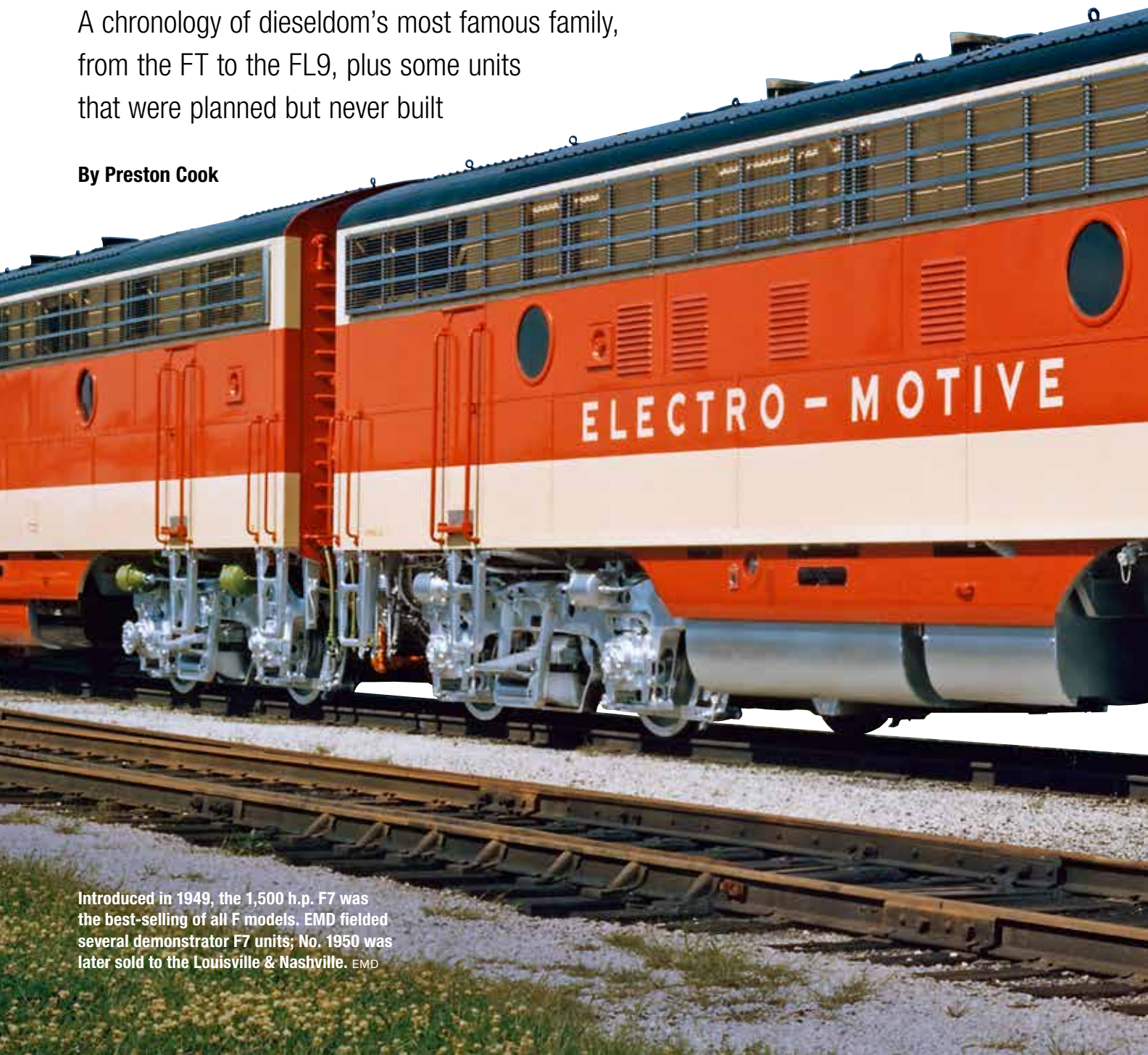
F units
T to 9

A chronology of dieseldom's most famous family, from the FT to the FL9, plus some units that were planned but never built

By Preston Cook



Introduced in 1949, the 1,500 h.p. F7 was the best-selling of all F models. EMD fielded several demonstrator F7 units; No. 1950 was later sold to the Louisville & Nashville. EMD

More than any other family of locomotives, Electro-Motive's F series was responsible for the railroads' transition from steam to diesel motive power. When the first F units hit the rails in late 1939, nearly every freight train was powered by steam; by the time production ended in 1960, mainline steam was finished. The revolution that began 75 years ago with FT demonstrator No. 103 is still regarded as the most profound change in railroad history.

1939 Change and challenge

Four-unit FT demonstrator No. 103 is at Denver with test cars and a freight on April 28, 1940, halfway through its nationwide tour. R. H. Kindig

No. 103 is dwarfed by a coaling tower at the Rock Island's Blue Island Yard outside Chicago. The FT and its successors would end the need for such costly infrastucture. Classic Trains coll.

FT	567, 567A • 1,350 h.p. • 11/39–11/45	
	A units	B units
ATSF	155	165
ACL	24	24
B&O	12	12
B&M	24	24
C&NW	4	4
CB&Q	32	32
CRI&P	20	16
DL&W	12	8
D&RGW	24	24
Erie	12	12
GN	51	45
LV	4	4
MILW	26	26
M&StL	4	2
MP	12	12
NYC	4	4
NYO&W	9	9
NP	22	22
RDG	10	10
SAL	22	22
SSW	10	10
SOU	38	30
WP	24	24
Total	**555**	**541**

Principal source, all tables: EMD *Locomotive Reference Data*; some quantities may differ from other published rosters

The sleek locomotive — model FT, road number 103 — that left the Electro-Motive Corp. plant near La Grange, Ill., on November 25, 1939, for an 11-month, 83,764-mile, 20-railroad, 35-state demonstration tour changed forever the way railroads looked and operated. The FT was the product of the design genius of Electro-Motive Engineering Department boss Richard M. Dilworth and his staff, but it was also the result of the vision and marketing skills of EMC founder and General Manager Harold Hamilton and General Motors President Alfred P. Sloan Jr. (Formed in 1922 to design and sell gas-electric railcars, EMC was acquired by General Motors in 1930 and became GM's Electro-Motive Division in 1941.)

The FT was both a locomotive and a challenge for an industry whose mechanical departments had been wedded to steam technology for many decades. Electro-Motive's sales effort began at a

difficult time, when the U.S. economy was in recession following a long, deep depression. But the builder was on a roll. Less than six years after the Union Pacific M-10000 and Burlington *Zephyr* had captured the public's attention with their bold styling and impressive speed, Electro-Motive had progressed to building multiple-unit diesels for heavy passenger service while also competing with Alco, Baldwin, and other firms that were entering the diesel switcher market. These builders, plus Canadian National Railways, had produced diesels for road freight service years before the FT, but they amounted to a handful of relatively light units with mixed performance records. Heavy-haul, long-distance freight operations had remained the realm of steam power until the FT arrived.

FT 103, consisting of four 1,350 h.p. units (two cabs and two boosters), could be operated as a 5,400 h.p. locomotive or split into two 2,700 h.p. locomotives. With full-width streamlined carbodies like those introduced on EMC's E-series passenger diesels in 1937, the machinery was well protected from the elements.

One great advance that made the FT possible and successful was the Electro-Motive 567U prime mover, a 45-degree, V-arrangement, two-stroke engine. The 567 was the result of years of work by a team of engineers who had learned through trial and error from the Winton 201 and 201A prime movers of 1932–38. (Winton Engine Co., EMC's prior supplier of gas and diesel engines, was acquired by GM in 1930.) Working with one- and two-cylinder test engines as well as production prototypes, the team led by Charles F. Kettering of GM Research, and expedited by his son Eugene Kettering, who worked for Winton and later for Electro-Motive, had designed and tested dozens of variants of engine components. The result of their efforts was an engine that produced more power in a smaller and lighter package than any other prime mover then available to the railroad industry, and did it with a level of reliability that ensured long-term acceptance.

A less obvious but similarly significant feature that made the FT capable of competing with steam locomotives was its electrical multiple-unit control system, which allowed the engineer in the lead cab to control up to four units as a single locomotive. Electro-Motive's involvement with diesel streamlined trains and its E-series passenger locomotives led it to early understanding that electrical m.u. controls were more reliable and adaptable than air-actuated systems.

Southern FT 6100 — the former EMD 103 — heads a freight near Burnside, Ky. Southern

1940 Santa Fe leads the way

Seven-year-old Santa Fe FTs led by A unit No. 110 employ dynamic braking as they descend California's famous Tehachapi grade with Bay Area-bound freight in 1949. Linn H. Westcott

Among the 20 railroads that demonstrator 103 visited, all but four eventually acquired production FTs. The first and best customer was Santa Fe, which hosted No. 103 for 32 days, during which the locomotive maintained 100 percent availability and was utilized 74 percent of the time. Santa Fe amassed by far the largest fleet of FTs — 320 units, nearly one-third of the total built — beginning with orders in 1940. Deliveries continued until August 1945.

Santa Fe's FTs incorporated two important advances over No. 103. First, instead of drawbars connecting the cab and booster units, Santa Fe favored completely separable and self-supporting units with couplers, corner stirrup steps, and safety grabs. Although other roads ordered drawbar-connected A-B (and even A-B-A) sets, the Santa Fe units established the pattern for later production of road freight diesels. In another divergence from 103's equipment, Santa Fe specified the FT's optional dynamic braking system, which used the traction motors as generators, feeding the generated electrical power to roof-mounted resistance grids, to assist in braking on grades. This greatly enhanced train handling in mountain territory and today nearly all new diesels have dynamics.

The early production FTs for Santa Fe used an improved model of the 567 engine, the 567V, which featured changes in construction to make the crankcases more durable. The only 16-cylinder examples of the earlier 567U were in FT 103's four units, and they were replaced with later engines before the demonstrator set was sold to Southern Railway.

1942 EMD goes to war; FTs multiply

Great Northern FT A-B set 251 heads the Seattle–Spokane (Wash.) *Cascadian* over Stevens Pass in May 1953. The FTs have been modified with F7-style grilles and large number boxes. At 96 units, GN's FT fleet trailed only Santa Fe's in size. George Krambles, Krambles-Peterson Archive

New York Central 1603, the last of the road's four FT A-B sets, ignores the steam locomotive track pans at Stryker, Ohio, as it rolls west with a freight in the late 1940s. Emery Gulash

Early in World War II, the U.S. Navy selected Electro-Motive as a supplier of engines for the Landing Ship Tank (LST) program. For part of the war, much of the production capacity at EMD was devoted to this project, restricting the number of locomotives that could be built. This and other Navy programs paid for several plant expansions and also allowed EMD top priority in obtaining machine tools during the war years, setting the stage for EMD's vast increase in postwar locomotive production.

When the War Production Board placed restrictions on the allocation of scarce diesel locomotives in 1942, it gave the Santa Fe — a vital route to the Pacific

Coast through miles of territory with little or no water for steam engines — first priority for acquiring more FTs to handle wartime traffic. The first WPB limitation letter governing locomotive production was issued May 13, 1942, and covered production through November. The second limitation letter, issued November 25, 1942, specified production for the first six months of 1943. These rulings meant that EMD produced no locomotives from December 1942 into February 1943. When production resumed in March '43, only FTs were permitted.

The WPB allowed production of the FT because it was the one proven and readily buildable multiple-unit road freight diesel available. EMD completed orders for E-unit passenger diesels that were received before the WPB restrictions took effect, but after that it would build no new passenger (or switching) locomotives until 1945. Other roads in the West ordering the FT were eventually allocated units based on Santa Fe's selected features, B&O and Southern got a few units in 1942, while other railroads had to wait until restrictions were eased to begin receiving FTs in late 1943.

Minneapolis & St. Louis 545 catches a bit of sun at Marshalltown, Iowa, on November 9, 1947. The drawbar-connected A-B-A set was half of M&StL's FT fleet. D. Christensen; F. and T. Novak coll.

During the emergency programs, space on the assembly floor at La Grange was so valuable that ways had to be found to streamline the process for all products. This resulted in a mid-war redesign of the FT to separate the locomotive into a series of subassemblies that could be quickly positioned and welded together [see page 39]. In early 1943, concurrent with the implementation of the design changes to the FT body, EMD introduced the 567A engine, which had been improved by changing the crankcase design to provide water cooling of the exhaust risers in the top deck of the engine. This change had been proposed for the Navy engines to reduce the instance of oil leakage and fire risk associated with it, and proved beneficial in locomotives.

By the time FT production ended in November 1945, 23 railroads had bought the model. The pump was more than primed for wholesale dieselization of America's railroad network.

1945 Redesigning the F unit

The F2 was produced briefly in 1946 while EMD developed a 1,500-h.p.-capable generator for the F3. Although much advanced over the FT, the F2 retained the FT's 1,350 h.p. rating. K. C. Crist

F2	567B • 1,350 h.p. • 7/46–11/46	
	A units	B units
A&EC	2	0
ACL	12	12
B&M	18	3
CB&Q	10	0
CRI&P	12	0
M&StL	2	1
Mexico	14	14
NYC	2	0
SOU	2	0
Total	**74**	**30**

Despite the partial redesign of the FT, EMD's Industrial Engineering Department estimated that the assembly of a four-unit FT in 1945 required 325,000 separate operations involving 40,000 man-hours — 20 years! — of labor.

The postwar market was expected to be highly competitive, with Alco known to be working on similar freight units and Baldwin expected to offer a product as well. Consequently, in 1944 Assistant Chief Engineer Eugene Kettering and the EMD Engineering Department began work on a new design that would be more suitable for mass production. Until that time, Gene Kettering mainly had been involved with the 567 engine. His participation in the development of FT successors revealed his great talent for "packaging" locomotive systems, and his innovative design work would help ensure the success of EMD's postwar line.

The new locomotive would be similar in size and styling to the FT, but would be extensively rearranged to accommodate the needs of more efficient produc-

Gulf, Mobile & Ohio had 12 dual-service F3s (9 As, 3 Bs), some ordered by the Alton; No. 880A leads a southbound freight across IC and IT tracks at Athol Tower in Lincoln, Ill., in July 1952. Rebuilt, this unit worked into the 2000s on Metro-North. George Krambles, Krambles-Peterson Archive

A cab-booster team of Jersey Central F3s grinds up the grade east of Fanwood, N.J., on August 18, 1951. As CNJ's fortunes fell, the units donned a somber dark green. Edward Theisinger

F3	567B • 1,500 h.p. • 7/45–2/49	
	A units	B units
A&R	2	0
A&StAB	1	0
ACL	12	12
ATSF	46	46
B&O	67	7
B&M	2	2
BAR	9	4
C&EI	16	7
C&NW	28	11
CB&Q	53	52
CGW	33	16
Clinchfield	6	3
CN	4	2
CNJ (CRP)	10	5
CofGa	9	0
D&RGW	6	6
DL&W	24	16
Erie	24	17
FEC	8	4
Georgia	1	0
GM&O	32	8
GN	53	24
GTW	22	0
KCS/L&A	21	20
L&N	2	3
LV	10	10
M&StL	6	0
MEC	8	2
MILW	8	8
MKT	14	7
Monon	24	6
MP	64	22
NC&StL	9	12
NP	25	24
NYC	34	18
NYO&W	5	2
PRR	80	40
RDG	6	6
SAL	11	0
SLSF	18	18
Soo	12	1
SOU	102	76
SP	80	80
SP&S	3	0
TP&W	1	1
UP	89	90
WM	2	0
WofAla	1	0
WP	3	6
Total	**1,106**	**694**

tion in larger volume. The cooling, lubricating oil, fuel, and electrical systems were completely revised to group related equipment and avoid the need for long pipe and cable runs. In conjunction with this "packaging" project, EMD's Martin Blomberg developed a revised carbody truss and batten system that would provide better weather protection for the machinery while allowing improved drainage for rainwater and melting snow that entered the carbody openings. (More fundamentally, the FT and virtually all other F units rode on a two-axle version of the A1A truck Blomberg had designed for the first E units in 1937.)

Meanwhile, EMD electrical design engineers were working on a more capable electrical transmission system, featuring a larger main generator designated model D12, which would be combined with a new version of the 567 engine, yielding a 1,500 h.p. rating.

The 567B engine

The postwar freight locomotive introduced an improved version of the 567 engine, the 567B.

The most visible change in the 567B was the introduction of a cast oil-strainer box at the front of the right bank of cylinders. This large aluminum housing eliminated the need to install and pipe a separate free-standing oil storage and strainer tank on the floor of the engine room. The flow of oil in the box was subdivided to serve both the scavenging system, which passes the oil through the filters and the oil cooler, and the main pressure system, which lubricates the engine bearings. The strainer box contained one coarse-mesh strainer to protect the intake of the scavenging oil pump, and two fine-mesh strainers to protect the main pump system. The fine-mesh strainers were to protect the engine if an oil filter element should break open, or if a rag or tools were left in the scavenging oil piping during maintenance.

The front housing and the blower support ducts on the 567B were aluminum, reducing the overall weight of the engine by about 1,000 lbs.

The 567B's main lube oil pump was enlarged to provide about 20 percent greater capacity than the previous de-

During 1948–50, Pennsy bought 69 F3s and F7s in A-B-A sets for helper service west of Altoona, Pa. The F3s had F7-style side panels, and all the As had PRR-specified small number boxes. On June 19, 1951, an F3 trio assists a 105-car freight up Horseshoe Curve. Edward Theisinger

sign. This allowed for higher operating pressure in the main lube oil system.

The air box drain piping on the 567B was built into the oil pan of the engine rather than being run externally, enabling the collection of drain oil at the front of the engine and dropping it into a sump rather than having four separate collection points.

The rear gear-train housing was completely redesigned, with oil lines running through drilled passages in the housing rather than through external piping bolted to pads on the housing. This cleaned up the rear of the engine while eliminating many oil-leakage points.

A power takeoff was added to the rear of the engine to provide shaft drive for the auxiliary generator and the main generator cooling fan. This eliminated a belt-drive arrangement used on the FT, and speeded up final assembly.

The 567B was fitted with the newly developed Woodward PG governor with internal load control pilot valve, which used engine oil pressure to drive and position a vane motor on the load regulator assembly. This replaced the predecessor

Bangor & Aroostook F3s 41 and 40, in their second paint scheme, pass the station at Caribou, Maine, with a freight in 1960. Sisters 44 and 46 still run [page 35]. E. B. King Jr., Dan Pope coll.

SI governor that used an external linkage to drive the load control equipment.

Accessory rack

The engine accessory rack, known as the "plumbing stack" in EMD internal terminology, was a major improvement introduced in the redesigned F unit. This assembly was a frame of welded steel angle stock that contained and supported the oil filter and oil cooler, the cooling-water expansion tank, the fuel filter, the fuel pump, and the engine control panel. It was built as a complete subassembly

Grand Trunk Western had only 22 cab units, F3As built in La Grange in 1948, three of which cross Washington Avenue in Lansing, Mich., in 1964 with hotshot 482. Jerry A. Pinkepank

along with all the necessary piping to connect the components with each other and with the engine, and was lowered onto the locomotive deck in final assembly. This got the remaining assembly operations reduced to simply connecting piping and electrical cables to the accessory rack, greatly reducing the time required for piping the engine. This grouping of accessories was largely the product of Eugene Kettering's design efforts.

Engine cooling system

The cooling system designed by Dick Dilworth for the FT used radiators in two separate roof-mounted groups, cooled by mechanical fans with belt drives from either end of the main engine. The two groups of fans could be individually declutched to reduce total cooling capacity in cold weather, and the radiator shutters were manually set. This fan system was time-consuming to position and align during construction.

For the postwar locomotive, Gene Kettering and his team developed a cooling unit mounted on the underside of a removable roof section, or "hatch," that incorporated nearly all the system's components. This hatch included two banks of radiators with their inlet and outlet headers, four cooling fan and motor assemblies, and all the necessary electrical conduit and water piping to connect the equipment with their controls and the engine and accessory rack piping. The hatch could be constructed as a complete subassembly and positioned on the locomotive in one crane operation, saving many man-hours during assembly.

Steam generators

One of the significant design drawbacks of the FT was the crowded arrangement of the rear of the engine room in the A units, which resulted in only the B units having space for steam generators to heat passenger trains. Some railroads ordered FTs with steam generators, but the fireman had to go all the way back to the rear of the B unit to tend the devices.

The rearrangement of the machinery in the postwar F, combined with the use of electric cooling fans that did not need mechanical drives, opened up enough space in the A units for a steam generator in the rear of the carbody. Placement of steam generators in A units enabled greater operating flexibility for the postwar Fs, although the limited space for water tanks in the A units led many roads to put steam generators in B units only.

Subassemblies

These various improvements allowed the locomotive to be constructed using a number of convenient subassemblies that were small enough to be moved easily within the shop and light enough to be lifted and positioned quickly. There were 14 subassemblies: 1) underframe; 2) platform; 3) side frames (truss structure); 4) cab; 5) accessory rack; 6) air-brake equipment rack; 7) engine; 8) generator; 9) traction motor blowers; 10) main electrical control cabinet; 11) steam generator and hatch (if used) or plain hatch; 12) cooling system hatch; 13) dynamic brake hatch (if used), water hatch (if used), or plain hatch; and 14) truck assemblies.

One of the most important changes in the design of the postwar F unit was the consolidation of engine room arrangements so that the A units and B units would be essentially identical from the front truck bolster to the rear of the locomotive. This further simplified the final assembly process by making tooling, fixtures, bill of materials, and assembly sequence the same for the engine room of both the cab and booster units.

False start: How F2 became F3

The postwar freight locomotive, which EMD originally intended to designate model F2, was planned to have a rating of 1,500 h.p. However, when the first demonstrators — an A-B-B-A set numbered 291 [page 48] — were completed in July 1945, it became evident that there were serious design problems with the new D12 main generator. Correcting these would take several months.

All the other logistics were in place to produce the new locomotive, so in order to allow manufacturing to proceed, EMD modified the D4 main generator of the FT, adding a companion alternator to allow its use in the new locomotive. This resulted in a 1,350 h.p. rating, the maximum the FT generator could accept. The change was done so quickly that designers forgot to put a critical drain hole in the bottom of the generator, where condensation was trapped by the addition of the companion alternator. Instructions went out to field service representatives along with a piece of paper showing how to position a long drill upwards through the bottom sheet of the carbody, and continue through the generator housing, to allow the water to drain.

EMD began building its new 1,350 h.p. locomotive in July 1946. As the first model to enter production after the FT, it received the designation F2. The reign of this stopgap model was brief — barely five months — before EMD solved the problems with the D12 generator, allowing 1,500 h.p. units to be built. When they entered production in November 1946, a new model was born: the F3, destined to be EMD's best-selling model to date. (Even though they predated the F2, the 1,500 h.p. units in the 291 demo set were considered F3s.)

If the FT had primed the pump of dieselization, the F3 was the first wave of the flood that would wash away steam.

1946 'Visible' F units

At the 1939–40 World's Fair in New York, Electro-Motive had displayed some of its E-unit passenger locomotives with glass side panels that allowed visitors to view the color-coded internal machinery. To promote its postwar freight locomotives, EMD in 1946 equipped several F3 (and later F7) booster units with removable side panels and spotlights for public display at events like trade shows and state fairs. The builder loaned out these "visible" F units to special railroad celebrations, and they often traveled with the host road's equipment as an additional display.

On arrival in a town, EMD personnel could remove the clipped-on side panels and convert the units for display in a relatively short time. When the units were not doing public displays, EMD shipped them to railroad shops for use as training aids.

EMD continued to use visible F units into the early 1950s. They can be identified in color photos of demonstrator sets by their green brake cylinders and red fuel tanks. All of the visible F units were eventually refitted as conventional locomotives and sold to customers.

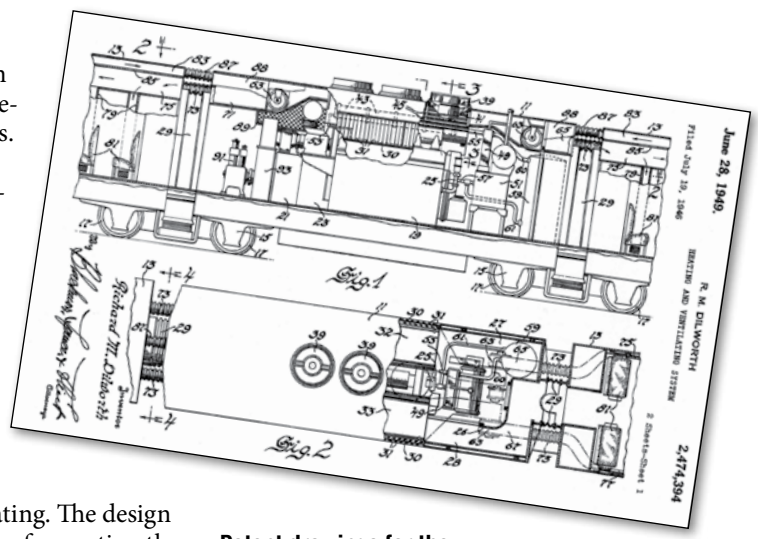
Green brake cylinders and a red fuel tank identify the B unit in F7 demo set No. 1950 (top) as a "visible" unit. A view of an F3B with side panels removed shows off the unit's innards. EMD

1948 The 'F5' and the F-unit power car

EMD's Sales Department didn't always agree with everything the Engineering Department proposed. An example of this occurred in 1948, when Engineering made a recommendation that, based on a number of changes being released to production, the F3 should receive a new model designation: F5. (The reason for skipping F4 is lost to history.)

This type of change required corresponding alterations to numerous publications, including the operator's and parts manuals, a complicated and sometimes expensive process. After initially announcing the F5 to field personnel on August 6, 1948, the Sales Department deemed the changes not worth applying a new model number, and rescinded the order on August 27, 1948. The first F5s would have been order E836, for Great Northern Nos. 430–438 (even numbers only). Consequently, production locomotives built to the Engineering F5 specification were carried in Sales Department records as F3s.

Not all of Dick Dilworth's imaginative designs made it into production. In 1948, he laid out plans for an F-unit-based mid-train power car that provided electric heating and air conditioning to the train. It also captured the engine's heat losses and used them for train heating. The design was far ahead of its time, forecasting the much wider use of head-end power systems in passenger service many years later. This remarkable piece of equipment was awarded U.S. Patent 2,474,394.



Patent drawings for the proposed mid-train power car show that it would have shared a pair of Blomberg trucks with adjacent coaches. It was to have been shorter than a standard F-unit booster.

1949 Lucky 7 series

Nearly new Atlantic Coast Line F7 420 leads an A-B-A consist on a freight extra south over the Norfolk Southern Railway crossing at Fayetteville, N.C., in spring 1952. EMD-oriented Coast Line had 230 F units of models FT, 2, 3, 7, 9, and FP7. Robert A. Caflisch, Helen Caflisch coll.

Wabash relied heavily on F7s, trying 9 A-B-A sets in 1949 (one poses brand-new at Montpelier, Ohio), then going for 54 F7A pairs, 22 built in Canada. Barney L. Stone, Krambles-Peterson Archive

F7	567B • 1,500 h.p. • 2/49–12/53	
	A units	B units
ACL	76	12
Alaska	5	4
ATSF	215	247
B&LE	28	26
B&M	4	4
B&O	157	100
C&NW	88	18
C&O	94	54
C&S	6	6
C&WC	6	0
CB&Q	10	3
CGW	4	19
Clinchfield	15	11
CN	58	18
CP	0	29
CRI&P	31	17
D&RGW	44	42
DL&W	9	6
Erie	6	6
FW&D	6	6
GM&O	4	10
GN	62	46
KCS/L&A	17	21
KO&G	4	2
L&N	69	17
LV	8	6
M&StL	8	0
Mexico	25	16
MILW	68	50
MKT	16	8
MP	50	12
NC&StL	23	8
NP	45	34
NYC	238	55
PRR	123	76
RDG	18	6
RF&P	10	10
SLSF	22	22
Soo	26	10
SOU	93	54
SP	294	236
SP&S	4	0
SSW	26	17
T&P	83	35
Tex-Mex	2	0
UP	17	35
WAB	126	9
WM	26	14
WP	24	26
Total	**2,393**	**1,463**

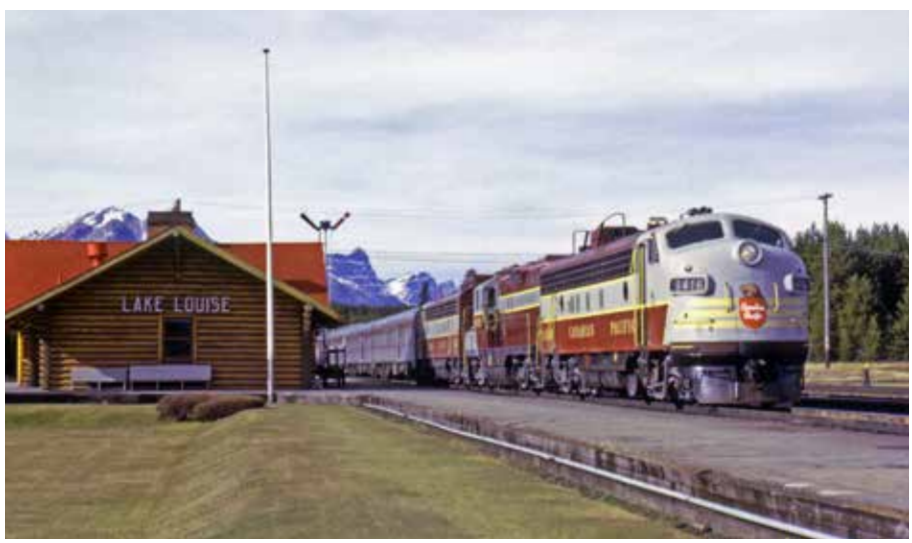
By 1949, Electro-Motive had enough product improvements to justify a change in the model series, and the F7 was introduced. (Again, why F6 was skipped is unknown.) Some of the external appearance features of this model, such as carbody grillework, were phased in during late F3 production, and the 567B engine was retained, with horsepower remaining at 1,500.

The F7 incorporated significant performance improvements to the transmission and dynamic-braking systems. Traction motors were of the higher capacity D27 type. The dynamic brake cooling fan was moved from inside the carbody to the roof.

With the F7, EMD introduced a companion model with provisions for long-haul passenger service, the FP7. In the F2 and F3, space to carry water for a train-heating boiler had been at a premium in the A units. This resulted in F cab units not having nearly the water capacity of the passenger E-unit line. However, some railroads favored F units over Es for the greater tractive effort available with higher weight per powered axle, and for their general utility as both freight and passenger power. The common solution for the lack of water capacity in the F-unit cabs was to take along booster units that might not have been needed for power but, with their greater water capacity, were essential to heat the train. Designers addressed this by adding 4 feet to the length of the F7A in which additional water could be stored [see page 56].

EMD's introduction of the GP7 road-switcher, internally the equivalent of an

Milwaukee Road F7s 89A and 89B handle freight in Chicago a few months after they were built in November 1949. The road's memorable orange and maroon scheme, initially for passenger diesels, was later adopted for freight cab units. Robert A. Caflisch, Helen Caflisch collection



Canadian Pacific 1416 leads an FP7-GP9-FP7 consist on the eastbound *Canadian* at Lake Louise, Alberta, in October 1964. All 83 of CP's Fs were bought for passenger duty. James A. Brown

FP7	567B • 1,500 h.p. • 6/49–12/53		
A&WP	4	NP	2
ACL	44	ONR	22
Alaska	3	PRR	40
C&EI	10	RDG	8
C&O	16	RF&P	3
CGW	2	Saudi Arabia	2
Clinchfield	1	SLSF	12
CP	35	SSW	1
CRI&P	10	Soo	8
FEC	5	SOU	20
Georgia	3	SP	16
L&N	45	UP	2
MILW	32	WofAla	2
MKT	8	WP	4
Mexico	18	**Total**	**378**

F7, in 1949 signaled the beginning of a decline in F-unit sales. Combining the power and speed capabilities of a road locomotive with the visibility and accessibility of a switcher, the road-switcher concept turned out to be extremely popular. As the railroads started to approach full dieselization, GP sales increased while F sales declined. The production numbers for later F models would continue to drop as the GP series went on to become one of EMD's most successful products. At more than 4,200 units, the 7 series was the top-selling F line; its successor, the 9 series, sold fewer than 600.

Throughout the early development of its locomotive products, Electro-Motive had relied on dynamometer cars based on passenger-car construction practices. Most of these were best suited to trail the

power consist, as few had pass-through multiple-unit capability and some were considerably lighter than the diesels they accompanied. With the increases in locomotive horsepower and improvements in dynamic-braking systems, EMD recognized the need for a test car based on locomotive construction and suitable to be operated in the middle of a consist.

ET-909, EMD's rolling laboratory, was introduced in July 1949. Resembling an F booster unit, it provided a full suite of recording instrumentation for drawbar pull, speed, throttle usage, and other variables that required monitoring. It had an on-board diesel generator, accommodations for four technicians, caboose-style bay windows, and spotlights for observing at night. The car served EMD's needs for four decades.

A model of EMD's F-unit-based test car ET-909 shows the monitoring area with small bay windows at one end (left in photo) and crew quarters in the other. EMD, Preston Cook collection

1953 The final F series

Northern Pacific's 71 units made it by far the top F9 owner; Nos. 7010A-7003B-7012B-7004D throttle up at Logan, Mont., in 1966. J. W. Swanberg

By the early 1950s, EMD engineers had come to recognize the 567B engine had some design drawbacks that were developing with age. One of the most severe problems involved the two large "O"-ring seals at the water deck along the bottom of the cylinder liners. As these hardened with age and heat exposure, the engine began to develop water leaks into the lubricating oil. These leaks also eroded the water deck edges, resulting in the need for welding repairs. At the same time, EMD's competitors were introducing more powerful four-stroke engines, an example being Alco's 251 series, which spurred EMD to compete in the developing horsepower race.

Around 1951, EMD designed a new model of the 567 that incorporated individual cylinder-liner water jumpers. The water jumper and manifold system elim-

Eleven new F9s worked Erie Mining's 70-mile iron-ore railroad in northern Minnesota when it opened in 1957, and some were still on the job when regular operations ended more than 40 years later. An A-B-B-B consist hauls loads toward Lake Superior in July 1988. Steve Glischinski

F9	567C • 1,750 h.p. • 1/54–4/57	
	A units	B units
ACL	2	0
ATSF	18	18
Clinchfield	0	5
CN	0	38
CP	0	8
D&RGW	2	4
Erie Mining	5	6
GN	0	6
KCS	3	2
L&N	8	4
MILW	6	6
MKT	0	4
Mexico	10	10
NP	38	32
SLSF	0	13
Total	**92**	**156**

Canadian National FP9 6508 and F9B 6608 power the *La Salle* out of Montreal in late 1957. CN had more than half of all FP9s built; many survive on tourist lines and business trains. Bob Krone

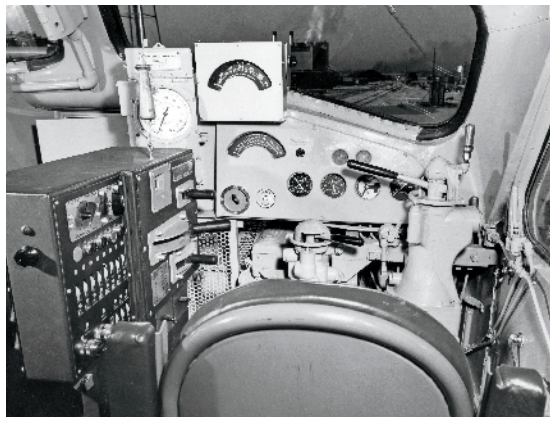
inated the need for the complex water deck plates, allowing for a stronger engine crankcase construction around the bottom of the cylinder assembly.

This formed the basis for the 567C engine, introduced in the F9 and FP9 in late 1953. The 567C was of the the same size and base configuration as the 567B and required minimal design changes in the locomotives. However, its increased 1,750 h.p. rating required improvements to the main generator and traction motors. Thus the D37 traction motor replaced the D27 used in the 7-series locomotives. External appearance changed slightly, thanks to the application on the 9-series units of Farr filter grilles, designed to provide some inertial filtering of air entering the carbody. This improvement was incorporated into some late 7-series units as well. Also, the headlight glass was changed to be flush with the edge of the housing, not recessed as on the 7 series, and the porthole/louver arrangement on the carbody sides was slightly changed. The classic "bulldog" nose remained the same, of course.

EMD engineers were sufficiently convinced of the superiority of the water jumper system in the 567C that they designed a "work-around" to apply the system to 567B crankcases. This resulted in what was termed a 567BC engine, which used "C" liners in a modified "B" crankcase. The modification was incorporated into some late F7s and FP7s, and was offered as an upgrade whenever an earlier model 567 came to EMD for rebuilding.

FP9	567C • 1,750 h.p. • 2/54–12/59
C&NW	4*
CN	43
CP	11
Mexico	25
Saudi Arabia	3
Total	**86**
*Rebuilt from FTs; 1,500 h.p., model FP9M	

1955 The longest F unit



The first two of New Haven's dual-power FL9s were built with Blomberg front trucks, which were soon replaced by Flexicoils with third-rail shoes. In the cab, extra controls and instrumentation were required for straight-electric operation. The 60 FL9s were NH's only F units. EMD

The five-axle FL9 was a late addition to the 9-series line. Electro-Motive had considered a five-axle format in the mid-1930s during the development of the first E units, which were descended from four-axle locomotives. The fifth axle would have allowed for additional fuel and water capacity, but the first E-unit buyer, Baltimore & Ohio, went even further by expressing a preference for a six-axle unit of even greater capability, and the builder went on to develop the E series with an A1A-A1A wheel arrangement. Fairbanks-Morse began building five-axle passenger units in 1950 for essentially the same reasons: more fuel and water capacity. For its version of the concept, EMD added another 4 feet to the FP9, and a three-axle rear truck, to get the B-A1A FL9.

The front truck would be a standard two-axle Blomberg with 40-inch wheels, as on all previous F units. Because the A1A version of the Blomberg used on E units could not accept wheels larger than 38 inches, and all wheels had to be the same diameter for wheelslip control purposes, a different design, the Flexicoil, was specified for the rear of the FL9. Although similar in appearance to the three-motor truck used on early six-motor SD models, an FL9's Flexicoil was of different bolster geometry and could not accommodate a traction motor on the center axle.

Early specifications for the FL9 showed it in a "long-distance" passenger configuration with a high-capacity steam generator and four water tanks totaling 2,850 gallons. No railroads ordered this version of the FL9, but an even more unusual variation, one that could operate as both a diesel-electric and a straight electric, did find a buyer.

The dual-power version of the FL9 had an oversize electrical cabinet with additional switchgear for third-rail operation, along with a combined dynamic brake and resistance grid hatch that would provide for cutting resistors in and out to control the locomotive in third-rail electric mode. The New Haven Railroad, seeking to replace straight electrics with diesels, but still requiring units capable of third-rail operation in New York tunnels, placed orders for a total of 60 FL9s. The first 30, built 1956–57, contained 567C engines, while the second (1960) ran on 567D1s. Since 1949, EMD road-switchers and F units used prime mover-based model designations (F7, GP7, and SD7 for 567B-engined units; 9-series suffixes for 567C units). EMD's 567D1-engined road-switchers were the GP18 and SD18, but instead of FL18 for NH's second batch of Fs, the builder for some reason stuck with FL9. Perhaps EMD saw that the F-unit era was ending, and indeed NH 2059 was the last F unit built.

The FL9 initially experienced teething problems related to third-rail shoe placement and other issues [page 78]. Once these were cured, the model went on to a career spanning more than 40 years.

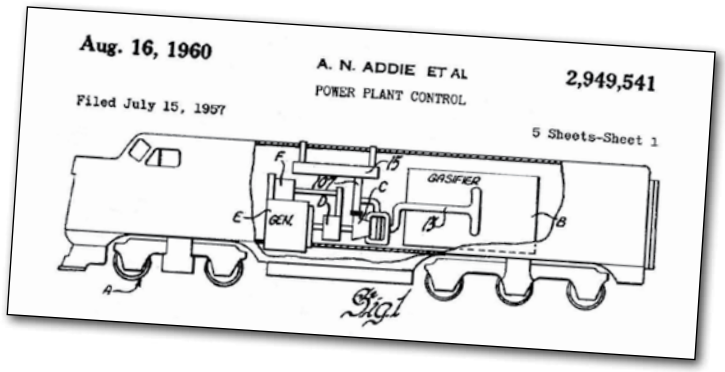
FL9	567C 1,750 h.p. 10/56–11/57	567D1 1,800 h.p. 9/60–11/60
New Haven	30	30

1956 Cooking with gas

By the late 1940s and early '50s there was already concern that the increased use of diesel engines in transportation applications might result in shortages of fuel. Interest developed in devices that would allow the use of lower-grade fuels, and one such device was the free-piston gasifier. The function of this machine was simply to burn fuel to produce heat energy that was piped to a gas turbine driving a locomotive's D.C. generator. The piston in the gasifier had no connecting rods; once started in motion by compressed air, it "bounced" back and forth in the cylinder, compressing an incoming air charge hot enough to ignite fuel that had been injected. Conventional No. 2 diesel fuel was used for starting and stopping the gasifier, while low-grade heavy fuel would be burned in operation. In order to carry all

the machinery, the carbody selected for the locomotive was an adaptation of the five-axle FL9, designated model FG9. EMD built a prototype FG9 and began testing while discussing the concept with Union Pacific as a possible first customer. The unusual FG9 locomotive is the subject of U.S. Patent 2,949,541, awarded to Albert (Norm) Addie, Hugh Williams, and Hugh Lafferty.

At the same time, GM's Cleveland Diesel Division was experimenting with gasifiers in a modified cargo ship. Those experiments, conducted with GM Research Labs, revealed that in addition to producing an ultra-irritating machine gun-like exhaust noise, the gasifiers also generated vibrations that could damage welded structures. These findings diminished enthusiasm for the concept considerably, and the gasifier projects at both EMD and Cleveland Diesel eventually disappeared.



Although EMD patented its design, the five-axle FG9 free-piston gasifier locomotive never entered production.

1958 Super F units?

EMD did preliminary design work on and prepared specifications and pricing for a final two F-unit models. The F18 would have used the 1,800 h.p. 567D1 engine found in the GP18 and SD18 road-switchers (and the second group of FL9s). The F20 would have been a real departure, being powered by a 2,000 h.p. 567D2 turbocharged prime mover as used in the GP20; as the most powerful and only turbocharged F unit, the F20 would have been an interesting conclusion to the series.

However, by the time these locomotives were being considered, the road-switcher had become preferred on most railroads, and neither "super F unit" was ever built.

2014 A remarkable record

When I worked at EMD in the 1970s, I used to talk with Bill Gardner, the assistant general service manager, during lunch hours. Bill's career with EMD spanned several decades, and he had very perceptive views on railroad history and the locomotive industry.

Referring to the F-unit line, Bill once commented, "We had a product that ran pretty well at a time when everybody else had products that were having a lot of problems." This was perhaps the closest Bill came to being wrong about something, for his remark severely understated the success and impact of the remarkable locomotive line that Electro-Motive launched in 1939.

The life expectancy of diesel passenger and freight locomotives built in the 1940s and '50s was generally 20 years or less. The technology was advancing rapidly in the late '50s and '60s, and the builders made attractive offers to turn in old locomotives in transactions for new ones. Nevertheless, a surprising number of railroads chose to retain F units in their fleets, particularly those where the locomotives were fitted with head-end power and continued to give years of reliable service in passenger operations, some lasting into the 21st century.

Ex-Bangor & Aroostook F3s restored by Tri-State Chapter NRHS and Anthracite Railroads Historical Society as Lackawanna 663-664 climb away from Scranton, Pa., on the old DL&W with their first Steamtown trip, June 5, 2011. DL&W had FTs, 3s, and 7s — 75 Fs in all. Richard Jahn

This in turn has resulted in a higher survival rate for these units in preservation, where many of them continue to pull tourist trains. Who could have predicted back in the 1940s that some of these classic locomotives — like the F3s that haul passengers at Steamtown National Historical Site, sharing shop facilities with some of the steam locomotives that their type helped to retire — would still be in frequent service more than 65 years after they were built? ■