Concrete Box Girder Superstructure Rating
Bridge 423.44

Rating Procedure

Bridge rating based on Equivalent Loading Method:
Equivalent E-80 rating was determined by comparing maximum moment and shear values of locomotives that use the structure with the maximum moment and shear values from E-80 loading.

The governing locomotive was an EMD SD70ACe which is a common locomotive for the Union Pacific Railroad.

Field survey conducted provided all the necessary information to rate bridge. Substructure not rated.

Rating Summary

Member	Rating	
	Normal	Maximum
Box Girder	51.6	N.A.

COMP. JRH

CK. TSK

DATE 3-23-16

WILSON & COMPANY

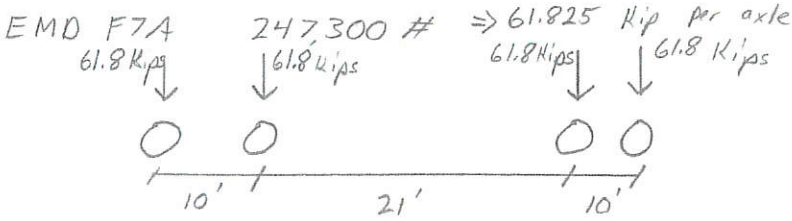
LOC. FILE

PROJ. VC TC SHEET

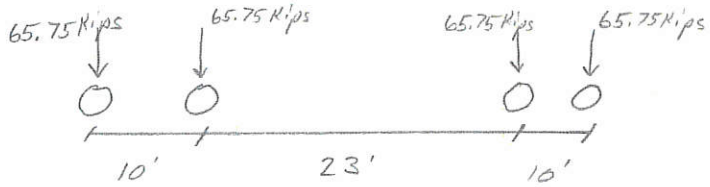
SUBJ. Axle weights OF

Locomotives operated on branch line by F&W

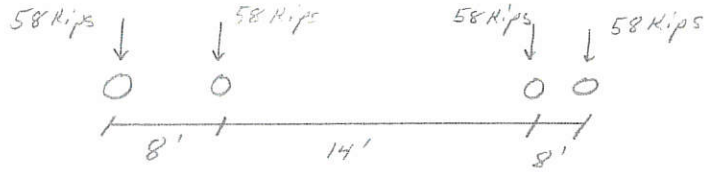
EMD F7A 247,300 # ⇒ 61.825 Kip per axle



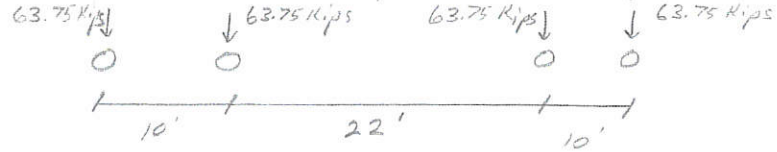
EMD GP35 263 to 266 Kips ⇒ 65.75 Kip per axle



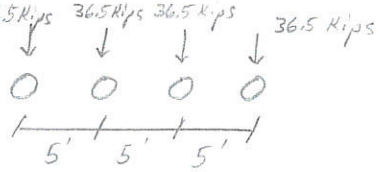
ALCO S6 232 to 235 Kips ⇒ 58 Kips per axle



ALCO RS32 255 Kips ⇒ 63.75 Kips per axle



Baldwin 2-8-0 Steam Locomotive 146 Kips ⇒ 36.5 Kips per axle



COMP. JRH

CK. TSK

DATE 3-24-16

WILSON & COMPANY

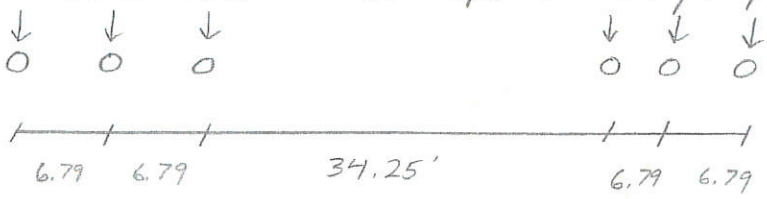
LOC. FILE

PROJ. VCTC SHEET

SUBJ. Axle weights OF

Common Locomotive operated by Union Pacific

EMD SD70ACe 420 kips => 70 kips per axle



COMP. JRH
CK. TSK
DATE 3-24-16

WILSON & COMPANY

LOC. FILE
PROJ. VCTC SHEET
SUBJ. Rating Calculation OF

E-80 Loading L = 30 feet

$M_{max} = 2 \times 45L - 530 + \frac{27.2}{L} = 2\left[45 \times 30 - 530 + \frac{27.2}{30}\right] = 1641.8$ Kip-ft [RISA]

$V_{max} = 252.1$ Kips [RISA]

From RISA [attached], max moment from locomotives = 1098.7 Kip-ft
and max shear = 162.47 Kips

$Rating = \frac{1098.7}{1641.8} \times 80 = 53.4$

$Rating = \frac{162.47}{252.1} \times 80 = 51.6$ ← Governs

Locomotive Moment and Shear

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diaphragm
1	N1	0	0	0	0	
2	N2	30	0	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N1	Reaction	Reaction	Reaction	Reaction	Reaction		
2	N2		Reaction	Reaction				

Moving Loads

	Tag	Pattern	Increment[ft]	Both Ways	1st Joint	2nd J...	3rd J...	4th J...	5th J...	6th J...	7th J...	8th J...	9th J...	10th ...
1	M1	EMDF7A	.1	Yes	N1	N2								
2	M2	EMDGP35	.1	Yes	N1	N2								
3	M3	ALCOS6	.1	Yes	N1	N2								
4	M4	ALCORS32	.1	Yes	N1	N2								
5	M5	BALDWIN2-8-0	.1	Yes	N1	N2								
6	M6	EMDSD70ACE	.1	Yes	N1	N2								

Moving Load Patterns

Pattern Label	Load (k)	Direction	Distance (ft)
EMDF7A	-61.825	V	0
	-61.825	V	10
	-61.825	V	21
	-61.825	V	10
EMDGP35	-65.75	V	0
	-65.75	V	10
	-65.75	V	23
	-65.75	V	10
ALCOS6	-58	V	0
	-58	V	8
	-58	V	14
	-58	V	8
ALCORS32	-63.75	V	0
	-63.75	V	10
	-63.75	V	22
	-63.75	V	10
BALDWIN2-8-0	-36.5	V	0
	-36.5	V	5
	-36.5	V	5
	-36.5	V	5

Pattern Label	Load (k)	Direction	Distance (ft)
EMDSD70ACE	-70	V	0
	-70	V	6.79
	-70	V	6.79
	-70	V	34.25
	-70	V	6.79
	-70	V	6.79

Load Combinations

	Description	Solve	PDe..	SRSS	B...	Fac...	BLC	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac...
1		Yes			M1	1																				
2		Yes			M2	1																				
3		Yes			M3	1																				
4		Yes			M4	1																				
5		Yes			M5	1																				
6		Yes			M6	1																				

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shea...	LC	Torque[k...	LC	y-y Moment[...	LC	z-z Moment[k-ft]	LC
1	M1	1	m...	0	1-1	162.33	6-137	0	1-1	0	1-1	0	1-1	0	1-1
2			m...	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1
3		2	m...	0	1-1	151.34	6-631	0	1-1	0	1-1	0	1-1	0	1-1
4			m...	0	1-1	-3.663	6-495	0	1-1	0	1-1	0	1-1	-238.958	6-631
5		3	m...	0	1-1	140.14	6-647	0	1-1	0	1-1	0	1-1	0	1-1
6			m...	0	1-1	-7.257	6-17...	0	1-1	0	1-1	0	1-1	-442.547	6-647
7		4	m...	0	1-1	128.94	6-663	0	1-1	0	1-1	0	1-1	0	1-1
8			m...	0	1-1	-10.99	6-17...	0	1-1	0	1-1	0	1-1	-612.279	6-1647
9		5	m...	0	1-1	118.23	6-200	0	1-1	0	1-1	0	1-1	0	1-1
10			m...	0	1-1	-14.723	6-17...	0	1-1	0	1-1	0	1-1	-746.716	6-200
11		6	m...	0	1-1	107.17	6-11...	0	1-1	0	1-1	0	1-1	0	1-1
12			m...	0	1-1	-20.93	6-12...	0	1-1	0	1-1	0	1-1	-846.3	6-694
13		7	m...	0	1-1	96.04	6-710	0	1-1	0	1-1	0	1-1	0	1-1
14			m...	0	1-1	-28.35	6-574	0	1-1	0	1-1	0	1-1	-910.774	6-1600
15		8	m...	0	1-1	84.84	6-726	0	1-1	0	1-1	0	1-1	0	1-1
16			m...	0	1-1	-35.537	6-17...	0	1-1	0	1-1	0	1-1	-990.426	6-658
17		9	m...	0	1-1	73.64	6-742	0	1-1	0	1-1	0	1-1	0	1-1
18			m...	0	1-1	-43.003	6-17...	0	1-1	0	1-1	0	1-1	-1059.837	6-1636
19		10	m...	0	1-1	62.93	6-279	0	1-1	0	1-1	0	1-1	0	1-1
20			m...	0	1-1	-51.94	6-16...	0	1-1	0	1-1	0	1-1	-1095.316	6-211
21		11	m...	0	1-1	51.94	6-773	0	1-1	0	1-1	0	1-1	0	1-1
22			m...	0	1-1	-62.93	6-11...	0	1-1	0	1-1	0	1-1	-1095.316	6-1126
23		12	m...	0	1-1	43.003	6-789	0	1-1	0	1-1	0	1-1	0	1-1
24			m...	0	1-1	-73.64	6-16...	0	1-1	0	1-1	0	1-1	-1059.837	6-721
25		13	m...	0	1-1	35.537	6-805	0	1-1	0	1-1	0	1-1	0	1-1
26			m...	0	1-1	-84.84	6-16...	0	1-1	0	1-1	0	1-1	-990.426	6-1573
27		14	m...	0	1-1	28.35	6-14...	0	1-1	0	1-1	0	1-1	0	1-1
28			m...	0	1-1	-96.04	6-16...	0	1-1	0	1-1	0	1-1	-910.774	6-685
29		15	m...	0	1-1	20.93	6-358	0	1-1	0	1-1	0	1-1	0	1-1
30			m...	0	1-1	-107.17	6-222	0	1-1	0	1-1	0	1-1	-846.3	6-1609

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shea...	LC	Torque[k...	LC	y-y Moment[...	LC	z-z Moment[k-ft]	LC
31		16	m...	0	1-1	14.723	6-852	0	1-1	0	1-1	0	1-1	0	1-1
32			m...	0	1-1	-118.23	6-11...	0	1-1	0	1-1	0	1-1	-746.716	6-1115
33		17	m...	0	1-1	10.99	6-868	0	1-1	0	1-1	0	1-1	0	1-1
34			m...	0	1-1	-128.94	6-15...	0	1-1	0	1-1	0	1-1	-612.279	6-732
35		18	m...	0	1-1	7.257	6-884	0	1-1	0	1-1	0	1-1	0	1-1
36			m...	0	1-1	-140.14	6-15...	0	1-1	0	1-1	0	1-1	-442.547	6-1562
37		19	m...	0	1-1	3.663	6-14...	0	1-1	0	1-1	0	1-1	0	1-1
38			m...	0	1-1	-151.34	6-15...	0	1-1	0	1-1	0	1-1	-238.958	6-1546
39		20	m...	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1
40			m...	0	1-1	-162.33	6-10...	0	1-1	0	1-1	0	1-1	0	1-1

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N1	max	0	1-1	162.47	6-1216	0	1-1	0	1-1	0	1-1	0	1-1
2		min	0	1-1	0	1-711	0	1-1	0	1-1	0	1-1	0	1-1
3	N2	max	0	1-1	162.47	6-301	0	1-1	0	1-1	0	1-1	0	1-1
4		min	0	1-1	0	2-1	0	1-1	0	1-1	0	1-1	0	1-1
5	Totals:	max	0	1-1	210	6-140	0	1-1						
6		min	0	1-1	0	6-437	0	1-1						

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N2			RIGID	None	None	RIGID	Typical

Loads: BLC 1,
Envelope Only Solution
Member z Bending Moments (k-ft) (Enveloped)

E-80 Moment and Shear

Company : Wilson and Company
Designer : JRH
Job Number : 15-400-186-00
Model Name :

Mar 24, 2016

Checked By:_____

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diaphragm
1	N1	0	0	0	0	
2	N2	30	0	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N1	Reaction	Reaction	Reaction	Reaction	Reaction		
2	N2		Reaction	Reaction				

Moving Loads

	Tag	Pattern	Increment[ft]	Both Ways	1st Joint	2nd J...	3rd J...	4th J...	5th J...	6th J...	7th J...	8th J...	9th J...	10th ...
1	M1	COOPER_E-80_N...	.1	Yes	N1	N2								

Moving Load Patterns

Pattern Label	Load (k)	Direction	Distance (ft)
COOPER_E-80_NOCARS	-40	V	0
	-80	V	8
	-80	V	5
	-80	V	5
	-80	V	5
	-52	V	9
	-52	V	5
	-52	V	6
	-52	V	5
	-40	V	8
	-80	V	8
	-80	V	5
	-80	V	5
	-80	V	5
	-52	V	9
	-52	V	5
	-52	V	6
	-52	V	5

Load Combinations

	Description	Solve	PDe..	SRSS	B...	Fac...	BLC	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac..	B...	Fac...
1		Yes			M1	1																		

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shea...	LC	Torque[k...	LC	y-y Moment[...	LC	z-z Moment[k-ft]	LC
1	M1	1	m...	0	1-1	250.72	1-22...	0	1-1	0	1-1	0	1-1	0	1-1
2			m...	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1
3		2	m...	0	1-1	230.56	1-22...	0	1-1	0	1-1	0	1-1	0	1-1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shea...	LC	Torque[k...	LC	y-y Moment[...	LC	z-z Moment[k-ft]	LC
4			m...	0	1-1	-2.6	1-26..	0	1-1	0	1-1	0	1-1	-364.042	1-2265
5		3	m...	0	1-1	210.933	1-263	0	1-1	0	1-1	0	1-1	0	1-1
6			m...	0	1-1	-5.373	1-26..	0	1-1	0	1-1	0	1-1	-666.105	1-263
7		4	m...	0	1-1	191.733	1-279	0	1-1	0	1-1	0	1-1	0	1-1
8			m...	0	1-1	-8.147	1-26..	0	1-1	0	1-1	0	1-1	-910.947	1-838
9		5	m...	0	1-1	172.533	1-295	0	1-1	0	1-1	0	1-1	0	1-1
10			m...	0	1-1	-13.173	1-26..	0	1-1	0	1-1	0	1-1	-1096	1-854
11		6	m...	0	1-1	155.733	1-22..	0	1-1	0	1-1	0	1-1	0	1-1
12			m...	0	1-1	-18.373	1-26..	0	1-1	0	1-1	0	1-1	-1294.105	1-260
13		7	m...	0	1-1	137.8	1-326	0	1-1	0	1-1	0	1-1	0	1-1
14			m...	0	1-1	-23.92	1-25..	0	1-1	0	1-1	0	1-1	-1452.632	1-276
15		8	m...	0	1-1	117.96	1-342	0	1-1	0	1-1	0	1-1	0	1-1
16			m...	0	1-1	-33.333	1-191	0	1-1	0	1-1	0	1-1	-1551.579	1-851
17		9	m...	0	1-1	98.267	1-21..	0	1-1	0	1-1	0	1-1	0	1-1
18			m...	0	1-1	-48.267	1-207	0	1-1	0	1-1	0	1-1	-1602.526	1-867
19		10	m...	0	1-1	79.067	1-21..	0	1-1	0	1-1	0	1-1	0	1-1
20			m...	0	1-1	-63.2	1-783	0	1-1	0	1-1	0	1-1	-1639.579	1-1629
21		11	m...	0	1-1	63.2	1-21..	0	1-1	0	1-1	0	1-1	0	1-1
22			m...	0	1-1	-79.067	1-798	0	1-1	0	1-1	0	1-1	-1639.579	1-289
23		12	m...	0	1-1	48.267	1-15..	0	1-1	0	1-1	0	1-1	0	1-1
24			m...	0	1-1	-98.267	1-814	0	1-1	0	1-1	0	1-1	-1602.526	1-2207
25		13	m...	0	1-1	33.333	1-15..	0	1-1	0	1-1	0	1-1	0	1-1
26			m...	0	1-1	-117.96	1-16..	0	1-1	0	1-1	0	1-1	-1551.579	1-2191
27		14	m...	0	1-1	23.92	1-12..	0	1-1	0	1-1	0	1-1	0	1-1
28			m...	0	1-1	-137.8	1-16..	0	1-1	0	1-1	0	1-1	-1452.632	1-1616
29		15	m...	0	1-1	18.373	1-12..	0	1-1	0	1-1	0	1-1	0	1-1
30			m...	0	1-1	-155.733	1-862	0	1-1	0	1-1	0	1-1	-1294.105	1-1600
31		16	m...	0	1-1	13.173	1-12..	0	1-1	0	1-1	0	1-1	0	1-1
32			m...	0	1-1	-172.533	1-16..	0	1-1	0	1-1	0	1-1	-1096	1-2194
33		17	m...	0	1-1	8.147	1-12..	0	1-1	0	1-1	0	1-1	0	1-1
34			m...	0	1-1	-191.733	1-16..	0	1-1	0	1-1	0	1-1	-910.947	1-2178
35		18	m...	0	1-1	5.373	1-13..	0	1-1	0	1-1	0	1-1	0	1-1
36			m...	0	1-1	-210.933	1-16..	0	1-1	0	1-1	0	1-1	-666.105	1-1603
37		19	m...	0	1-1	2.6	1-13..	0	1-1	0	1-1	0	1-1	0	1-1
38			m...	0	1-1	-230.56	1-925	0	1-1	0	1-1	0	1-1	-364.042	1-925
39		20	m...	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1
40			m...	0	1-1	-250.72	1-940	0	1-1	0	1-1	0	1-1	0	1-1

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N1	max	0	1-1	252.133	1-1721	0	1-1	0	1-1	0	1-1	0	1-1
2		min	0	1-1	0	1-1341	0	1-1	0	1-1	0	1-1	0	1-1
3	N2	max	0	1-1	252.133	1-381	0	1-1	0	1-1	0	1-1	0	1-1
4		min	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1	0	1-1
5	Totals:	max	0	1-1	424	1-377	0	1-1						
6		min	0	1-1	40	1-30	0	1-1						

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N2			RIGID	None	None	RIGID	Typical

Loads: BLC 1,
Envelope Only Solution
Member z Bending Moments (k-ft) (Enveloped)

Electro-Motive Diesel

In more than 90 years of technology leadership, EMD has delivered over 62,000 locomotives to customers in 75 countries. EMD products have performed in nearly every imaginable condition — from the sands of the Sahara, to the heights of the Andes, to the demanding grades of the Powder River Basin.

With superior performance, we have helped our customers achieve their goals and earned a reputation for top quality, service and innovation...establishing EMD as the world's premier provider of diesel-electric locomotives.

The SD70ACe Locomotive

EMD introduced the SD70ACe locomotive in 2005 with advanced technologies for safety, reliability and sustainability.

A service-proven workhorse, the SD70ACe is in operation across the globe — providing superior performance for rail customers in North America, South America, the Middle East, Africa and Australia.

Features and Benefits

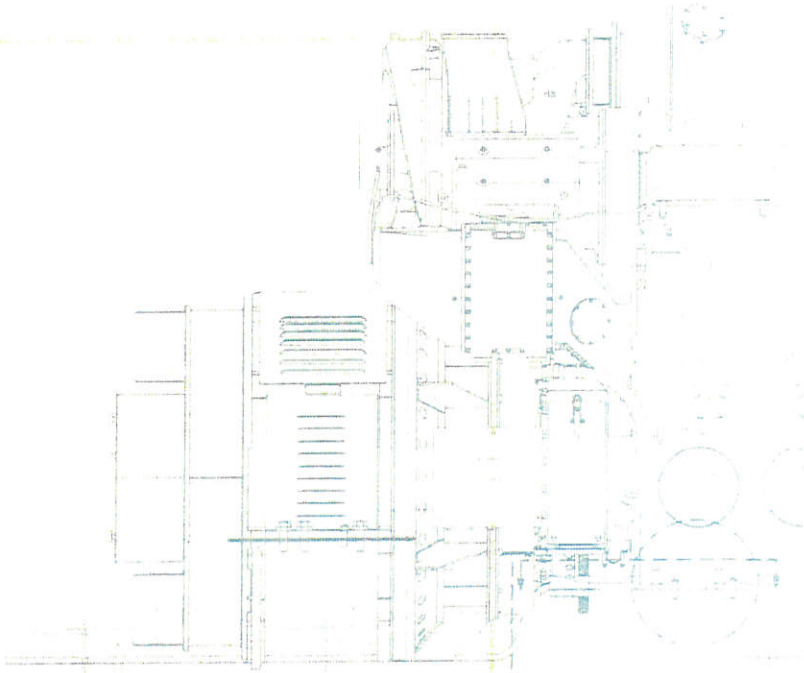
- Highly reliable 16-cylinder 710 engine
- Certified through EPA Tier 3 emissions
- EM2000™ microprocessor control system
- Durable AC traction
- 184-day maintenance interval
- Optional high-adhesion package
- Available with fuel management technologies including SmartConsist™
- Optional Intellitrain™ remote monitoring and diagnostic services

Natural Gas Locomotives

EMD is making substantial investments in natural gas technologies to further reduce fuel costs for the SD70ACe locomotive, while maintaining leading performance and safety.

Technical Details

	SD70ACe	SD70ACe-P4
Traction Horsepower	4300 THP	4300 THP
Maximum Speed	70 MPH	70 MPH
Number of Axles/Powered	6/6	6/4
Continuous Tractive Effort	155,000 lbs	116,000 lbs
Starting Tractive Effort	189,000 - 200,000 lbs	144,000 lbs
Dynamic Braking Effort	105,000 lbs	78,000 lbs
Weight	420,000 - 432,000 lbs	420,000 lbs
Length	74' 3"	74' 3"
Height	16' 1"	16' 1"
Fuel Capacity	4900 gallons	4900 gallons



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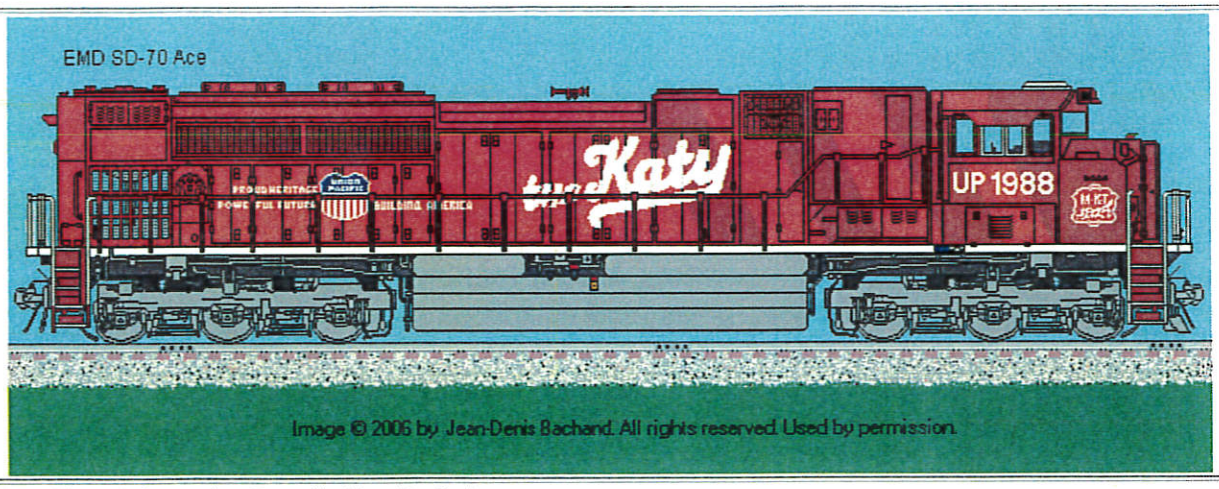
ELECTRO-MOTIVE DIESEL 9301 WEST 55TH STREET LAGRANGE, IL 60525 USA 1.708.387.5853 EMDIESELS.COM

EMD SD70ACe



Data Sheet Information Compiled by: R. Craig	
New: 11 September 2006	Artwork by: Jean-Denis Bachand
-	
Engine Builder: EMD	Engine: 710G3C-ES 16 cylinder
Bore & Stroke	9.02" X 11"
RPM (Maximum / Minimum)	904 /318
Main Generator: GM TA17 CA7A	Horsepower: 4300
Gear Ratio: 70:17	Speed: 70 mph
Trucks: HTC-RII 6-Wheel	Configuration: C-C
Weight: 408,000 lbs	Traction Motors: Six GM A3432
Traction Motor Blowers: Delco (4)	Model: Electrical Drive
Weight: 408,000 lbs	Traction Motors: Six GM A3432
Tractive Effort (starting) 191,000 lbs @ 35%	Tractive Effort (continuous): 157,000 lbs @ 12 mph
Multiple Unit Capability: Yes	Dynamic Braking: Yes
Auxilary Generator: GM A8589	Alternator: GM CA7A
Air Brake: Westinghouse	Model: 26L
Compressor: Gardner-Denver	Model: WLA5C
Quantity Built: 1435	Dates: 4 2003 to date
-	-
Exterior Dimensions	SD70ACe
Total Length	74'-03"
Wheel Diameter	42"
Truck Wheel Base	13'-07"
Height	15'-11"
Cab Width	10'-03"
Top of Walkway	9'-04.5"
Distance between Truck Centers	47'-10"
Locomotive Wheel Base	61'-05"
Minimum Turning Radious	29 degrees
-	-

Fuel Oil: 4900	Lubricating Oil: 420
Engine Cooling Water: 275	Sand Capacity: 40 cu. ft.
Options:	
-	
Reference Sources: • Diesel Locomotives, Vol. 2, by Bob Hayden • Illustrated Treasury of GM Locomotives by James W. Kerr • Diesel Locomotives, The First 50 Years, by Louis A. Marre • Diesel Locomotives by Greg McDonnell	

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