Locomotive Idling Reduction

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Historically, locomotives have been allowed to idle when not in use.

- Why let them idle?
  - Prevent freezing
  - Charge batteries and air reservoirs
  - Possible difficulty restarting
  - Provide for crew comfort
- What's to be gained by shutting them down?
  - Reduce emissions
  - Save fuel
  - Reduce noise
  - Extend engine service life
  - Reduce maintenance

Locomotive Emissions Standards Applicability

Year>>>		pre-2000	2000	2001	2002	2003	2004	2005	2006	2007
New Locomotives	Freight	No control	710 - Tier 0		Tier 1			Tier 2		
	Passenger		No control							
Remanufactured Locomotives	Pre-1973	No control	No control		No Federal control unless upgraded; will states regulate?					
	1973-1989		No control		Tier 0					
	1990-1993		Tier 0 if kit available							
	1994-1997		710 - Tier 0							
	Passenger		No control							Tier 0

- Standards apply to freshly manufactured locomotives starting in 2000, and to remanufactured locomotives originally built 1973 and later, phasing in 2000 - 2002.
- “710” refers to GM-EMD two-stroke cycle engine.
- 2000 - 2001 period subject to “Interim Provisions” of 40 CFR 92.12; several options available, option chosen by GM-EMD shown.

Locomotive Emissions Duty Cycles

	Weighting Factors	
Throttle Notch	Line haul	Switch
8 (Full load)	16.20%	0.80%
7	3.00%	0.20%
6	3.90%	1.50%
5	3.80%	3.60%
4	4.40%	3.60%
3	5.20%	5.80%
2	6.50%	12.30%
1	6.50%	12.40%
Idle	38.00%	59.80%
Dynamic brake	12.50%	0.00%
Totals	100.00%	100.00%

- EPA set two cycles because of concern for emissions in urban areas.
- Most locomotives have to conform to standards on both cycles.
- Line haul cycle emphasizes full load, switch cycle emphasizes idle.
- Both cycles derived from actual railroad operation.
- In practice, line haul cycle standards are the more stringent.

Locomotive Emissions Standards

	Tier 0		Tier 1		Tier 2	
Constituent	Freight	Switch	Freight	Switch	Freight	Switch
NOx, g/bhp-hr	9.5	14	7.4	11	5.5	8.1
PM, g/bhp-hr	0.6	0.72	0.45	0.54	0.2	0.24
HC, g/bhp-hr	1	2.1	0.55	1.2	0.3	0.6
CO, g/bhp-hr	5	8	2.2	2.5	1.5	2.4
Smoke - Steady State	30%		25%		20%	
Smoke - 30-second average	40%		40%		40%	
Smoke - 3-second average	50%		50%		50%	

- Tier 0 standards reduce NOx 33% from uncontrolled, cap other emissions.
- Tier 1 standards reduce NOx 50%, cap gaseous and PM emissions.
- Tier 2 standards reduce NOx 67%, cut gaseous and PM emissions roughly in half.
- Smoke is normalized over 1 meter path length.

What is the significance of idle reduction in emissions standards conformity?

Locomotive Idle Emissions									
	Locomotive	Tier 0 GP38-2		Tier 0 SD70M		Tier 1 SD70M		Tier 2 SD70ACe	
	Engine	16-645E		16-710G3B-T0		16-710G3B-T1		16-710G3C-T2	
	Constituent	NOx	PM	NOx	PM	NOx	PM	NOx	PM
Idle Duty Cycle Contribution, g/hr	Line haul	217	6	437	5	243	7	314	14
	Switch	341	10	687	7	382	10	495	21
Idle Percentage Contribution	Line haul	4.6%	2.3%	4.4%	2.7%	3.4%	1.7%	5.0%	15.0%
	Switch	19.8%	11.1%	17.8%	11.7%	16.0%	9.4%	18.3%	35.5%

Total Idle Contributions on EPA Cycles:

	Line haul	Switch
NOx	3-5%	16-20%
PM	2-15%	9-35%

EPA allows estimate of idle reduction in determining locomotive duty cycle emissions.

Significance of idle reduction in emissions standards conformity (2)

- Not all idle can be eliminated.
  - About 1/3 of idle is “in service” and must occur.
- Idle elimination is of limited utility in meeting emissions standards.
  - Steps between standards larger than emissions avoidable by limiting idle.
  - Some Tier 0 switchers can be made to conform by reducing idle.

Locomotive idle reduction: How do you do it?

- Newer EMD locomotives have automatic idle reduction systems built in.
  - Systems basic on 2005 EPA Tier 2 locomotives
  - Available on locomotives built in 2001-2004
- Several aftermarket systems are available for older locomotives (no endorsement implied):
  - ZTR Smart-Start
  - Kim HotStart
  - CSXT APU application

GM-EMD Automatic Engine Stop-Start (AESS) System

Basic on 2005 Tier 2 locomotives, optional on Tier 1 units.

Setup Requirements:

- Locomotive stopped
- Brakes set
- Throttle in idle
- Reverser centered
- Brake reservoir pressure adequate

Setup enables AESS.

Parameters sensed:

- Battery state
- Cooling water temperature
- Starting air reservoir pressure
- Ambient temperature
- Start frequency

Logic decides to stop or start engine.
Result: Idling cut approximately 50 per cent.

Questions?