

APPENDIX C

Data Descriptions

Data Acquisition FILE FORMAT - Acela Brake Test - May 9, 2005

During each data acquisition run, 3 files are generated.

1) Principal Data File, xxxxxxxx.abt

Binary Integer File, containing:

- a) Header record, 2 integers (4 bytes, 2 bytes/integer), followed by
- b) Sequential records of integer data, 32 integers/record (2 bytes/integer, 64 bytes/record)
 - Record 2: 32 integers (64 bytes); channels 1 - 32, at time t=0 seconds
 - Record 3: 32 integers (64 bytes); channels 1 - 32, at time t=1/1200th seconds
 - Record 4: 32 integers (64 bytes); channels 1 - 32, at time t=2/1200th seconds
 - ... etc.

Nominal Sampling Rate = 1200 samples/second

Nominal Time between Samples = 0.00083 seconds

PRINCIPAL DATA FILE HEADER RECORD - 4 bytes total					
Byte Nos	Type	Parameter	Units	Nominal Value	No of Bytes
1 - 2	1 integer	no of columns (channels) per data record		32	2
3 - 4	1 integer	sample rate	samples/s	1200	2
Total					4

PRINCIPAL DATA FILE RECORD - 32 integers (64 bytes)				
Chan	Parameter	File Scale Factor [actuals in .Cal file]	Units	File Offset [actuals in .Cal file]
1	Strain gage, center rotor spoke	1	uE	0
2	Strain gage, center rotor spoke	1	uE	0
3	Strain gage, center rotor spoke	1	uE	0
4	Strain gage, center rotor spoke	1	uE	0
5	Strain gage, outer rotor spoke	1	uE	0
6	Strain gage, outer rotor spoke	1	uE	0
7	Strain gage, outer rotor spoke	1	uE	0
8	Strain gage, outer rotor spoke	1	uE	0
9	Thermocouple, center rotor spoke	10	F	0
10	Temperature, braking surface, infra-red, center rotor	10	F	0
11	Temperature, braking surface, infra-red, center rotor	10	F	0
12	Temperature, braking surface, infra-red, outer rotor	10	F	0

13	Temperature, braking surface, infra-red, outer rotor	10	F	0
14	Speed sine wave from resolver	1000		0
15	Speed from resolver	100	g	0
16	Lateral Acceleration, axle mounted near rotor	100	g	0
17	Lateral Acceleration, Axle Box left	100	g	0
18	Vertical Acceleration, Axle Box left	100	g	0
19	Lateral Acceleration, Axle Box right	100	g	0
20	Vertical Acceleration, Axle Box right	100	g	0
21	Lateral Acceleration, center caliper near pad	100	g	0
22	Vertical Acceleration, center caliper near pad	100	g	0
23	Longitudinal Acceleration, center caliper, near pad	100	g	0
24	Lateral Acceleration, center caliper, near actuator	100	g	0
25	Vertical Acceleration, center caliper, near actuator	100	g	0
26	Longitudinal Acceleration, center caliper, near actuator	100	g	0
27	Lateral Acceleration, outer caliper, near pad	100	g	0
28	Vertical Acceleration, outer caliper, near pad	100	g	0
29	Longitudinal Acceleration, outer caliper, near pad	100	g	0
30	Brake Pipe Pressure	100	psi	0
31	Brake Cylinder Pressure, center caliper	100	psi	0
32	Brake Park Pressure, center caliper	100	psi	0

2) GPS Data File, xxxxxxxx.gps

Ascii File, containing:

- a) Sequential records of data, Ascii format, 5 columns, space delimited, 41 characters/record (1 byte/character, 41 bytes/record)
- Record 1: 41 characters (41 bytes); gps data at time t=0 second
- Record 2: 41 characters (41 bytes); gps data at time t=1 second
- ... etc.

Sampling Rate = 1 sample/second

GPS Data File Format - Space Delimited			
Column	Parameter	Units	Nominal No. of Characters
1	GPS time, seconds past midnight Greenwich	sec	6
2	Latitude	deg	12
3	Longitude	deg	13
4	Speed	mph	6
5	No. of Satellites		4

3) Calibration File, xxxxxxxx.cal

Ascii File, containing:

- a) 1 record for each data channel (total of 32), Ascii format, 5 columns, space delimited
 Record 1: calibration data
 Record 2: 41 characters (41 bytes); gps data at time t=1 second

Column	Parameter	Units	Nominal No. of Characters
1	Sensor gain – required only for record	e.g. V/g	8
2	Sensor offset - required only for record	deg	8
3	File Scale Factor - necessary to convert file data to engineering units	deg	8
4	File Offset - necessary to convert file data to engineering units	mph	8
5	Channel description and units		~ 24

Note: Each integer stored in the .abt file must be divided by the respective file scale factor to obtain correct engineering units.

Data Acquisition FILE FORMATS - Acela Brake Test - May 24, 2005

During each data acquisition run, May 26 - 27, 2005, 4 files will be generated.

1) Principal Data File, 3000 Sampling Rate: xxxxxxxx.ab2

Binary Integer File, Intel format, integers in the range -32768 to +32768, containing:

- a) Header record, 2 integers (4 bytes, 2 bytes/integer), followed by
- b) Sequential records of integer data, 32 integers/record (2 bytes/integer, 64 bytes/record)
 - Record 2: 32 integers (64 bytes); channels 1 - 32, at time t=0 seconds
 - Record 3: 32 integers (64 bytes); channels 1 - 32, at time t=1/3000th seconds
 - Record 4: 32 integers (64 bytes); channels 1 - 32, at time t=2/3000th seconds
 - ... etc.

Nominal Sampling Rate = 3000 samples/second

Nominal Time between Samples = 0.00033 seconds

Principal Data File “.ab2” HEADER RECORD - 4 bytes total					
Byte Nos	Type	Parameter	Units	Nominal Value	No of Bytes
1 - 2	1 integer	no of columns (channels) per data record		32	2
3 - 4	1 integer	sample rate	samples/s	3000	2
Total					4

Principal Data File “.ab2” RECORD - 32 integers (64 bytes)				
Chan	Parameter	File Scale Factor [actuals in .Cal file]	Units	File Offset [actuals in .Cal file]
1	Strain gage, center disc spoke 6, F1	1	uE	0
2	Strain gage, center disc spoke 6, F2	1	uE	0
3	Strain gage, center disc spoke 6, R1	1	uE	0
4	Strain gage, center disc spoke 6, R2	1	uE	0
5	Strain gage, center disc spoke 3, R1	1	uE	0
6	Strain gage, center disc spoke 3, R2	1	uE	0
7	Strain gage, axle near center disc adjacent spoke 6	1	uE	0
8	Strain gage, axle near center disc adjacent spoke 3	1	uE	0
9	Strain gage, axle near ¼ location, adjacent spoke 6	1	uE	0
10	Strain gage, axle near ¼ location, adjacent spoke 3	1	uE	0
11	Thermocouple, back of friction ring	10	deg F	0
12	Temperature, braking surface, infra-red, center rotor	10	deg F	0
13	Temperature, braking surface, infra-red, center rotor	10	deg F	0

14	Sine wave from resolver	1000		0
15	Calculated speed from resolver	100	mph	0
16	Lateral Acceleration, axle mounted near rotor	100	g	0
17	Lateral Acceleration, Axle Box left	100	g	0
18	Vertical Acceleration, Axle Box left	100	g	0
19	Lateral Acceleration, Axle Box right	100	g	0
20	Vertical Acceleration, Axle Box right	100	g	0
21	Lateral Acceleration, center caliper near pad	100	g	0
22	Vertical Acceleration, center caliper near pad	100	g	0
23	Longitudinal Acceleration, center caliper, near pad	100	g	0
24	Lateral Acceleration, center caliper, near actuator	100	g	0
25	Vertical Acceleration, center caliper, near actuator	100	g	0
26	Longitudinal Accel, center caliper, near actuator	100	g	0
27	Lateral Acceleration, axle mounted (piezo-electric)	100	g	0
28	File Synchronization signal	1000	g	0
29	Lateral Acceleration, axle (strain-based)	100	g	0
30	Brake Pipe Pressure	100	psi	0
31	Brake Cylinder Pressure, center caliper	100	psi	0
32	Brake Park Pressure, center caliper	100	psi	0

Note: Each data integer stored in the .ab2 file must be divided by the respective file scale factor to obtain correct engineering units. i.e. Physical data value (engineering units) = integer / file scale factor - offset

2) GPS Data File: xxxxxxxx.gps

Ascii File, containing:

- a) Sequential records of data, Ascii format, 6 columns, space delimited, and trailing text giving location w.r.t. milepost, nominally 72 characters/record (1 byte/character, ~72 bytes/record)
 - Record 1: ~72 characters (41 bytes); gps data at time t=0 second
 - Record 2: ~72 characters (41 bytes); gps data at time t=1 second
 - ... etc.

Sampling Rate = 1 sample/second

GPS Data File Format - Space Delimited			
Column	Parameter	Units	Nominal No. of Characters
1	GPS time, seconds past midnight Greenwich	sec	6
2	Latitude	deg	12
3	Longitude	deg	13
4	Speed	mph	6
5	No. of Satellites		4
6	Corresponding time in the .AB2 data file	sec	6
7	Text giving location with respect to Milepost		25

3) Calibration File: xxxxxxxx.cal

Ascii File, containing:

- a) 1 record for each data channel (total of 32), Ascii format, 5 columns, space delimited

Column	Parameter	Units	Nominal No. of Characters
1	Sensor offset - required only for documentation	V	11
2	Sensor gain – required only for documentation	e.g. mV/g	11
3	File Scale Factor - necessary to convert file data to engineering units		8
4	File Offset - necessary to convert file data to engineering units		8
5	Channel description and units		~ 24

Note: Each data integer stored in the .ab2 file must be divided by the respective file scale factor to obtain correct engineering units. i.e. Physical data value (engineering units) = integer / file scale factor - offset

4) Data File, 10,000 Sampling Rate: xxxxxxxx.001

Binary Integer File, Motorola format, integers in the range –32768 to +32768, containing:

- a) Date record, 4 integers (8 bytes, 2 bytes/integer), followed by
- b) Sequential records of integer data, 16 integers/record (2 bytes/integer, 32 bytes/record)
 - Record 2: 16 integers (32 bytes); channels 1 - 16, at time t=0 seconds
 - Record 3: 16 integers (32 bytes); channels 1 - 16, at time t=1/10000th seconds
 - Record 4: 16 integers (32 bytes); channels 1 - 16, at time t=2/10000th seconds
 - ... etc.

Nominal Sampling Rate = 10000 samples/second

Nominal Time between Samples = 0.00010 seconds

Data File DATE RECORD - 8 bytes total					
Byte Nos	Type	Parameter	Units	Nominal Value	No of Bytes
1 - 2	1 integer	Date0			2
3 - 4	1 integer	Date1			2
5 - 6	1 integer	Date2			2
7 - 8	1 integer	Date3			2
Total					8

DATA FILE RECORD - 16 integers (32 bytes)				
Chan	Parameter	File Scale Factor	Units	File Offset
1	Vertical Acceleration, Axle Box Left	2.04800	g	0
2	Lateral Acceleration, Axle Box Left	2.04800	g	0
3	Vertical Acceleration, Axle Box Right	2.04800	g	0
4	Lateral Acceleration, Axle Box Right	2.04800	g	0
5	Lateral Acceleration, Axle (piezo-electric)	4.034560	g	0
6	Lateral Acceleration, Axle (strain-based)	2.06848	g	0
7	Strain gage, center rotor spoke 6, R1	0.1732267	uE	0
8	Strain gage, center rotor spoke 6, R2	0.1732267	uE	0
9	Strain gage, center rotor spoke 3, R1	0.1732267	uE	0
10	Strain gage, center rotor spoke 3, R2	0.1732267	uE	0
11	Strain gage, axle near center disc adjacent spoke 6	0.1732267	uE	0
12	Strain gage, axle near center disc adjacent spoke 3	0.1732267	uE	0
13	Strain gage, axle near ¼ location, adjacent spoke 6	0.1732267	uE	0
14	Strain gage, axle near ¼ location, adjacent spoke 3	0.1732267	uE	0
15	Sine wave from resolver	204.800	Volts	0
16	Synchronization pulses	204.800	Volts	0

Note: Each data integer stored in the .001 file must be divided by the respective file scale factor to obtain correct engineering units. i.e. Physical data value (engineering units) = integer / file scale factor - offset

CMSW32 Data Storage

CMSW32 stores test data in two files:

- *.CMW – Header File
- *.001 – Data File

Format of Header File (*.cmw)

Variable	Variable Type	No. of Bytes	Expected/ Default Values
Separator?	1 byte	1	
File Identifier	String [10]	10	'CMW32V2.1'
Separator?	1 byte	1	
Test Description	String [50]	50	
Separator?	1 byte	1	
Test Engineer	String [50]	50	
Separator?	1 byte	1	
Job Number	String [50]	50	
Separator?	1 byte	1	
Test Title	String [50]	50	'Acela Evaluation'
Number of Channels	Integer (4 byte)	4	16
Save Mode (for internal use)	Byte	1	
Total Bytes in Section 1		220	
Channel structure (x300 channels)			
Channel On	Boolean	1	
Separator?	1 byte	1	
Channel Description	String[30]	30	
Separator?	1 byte	1	
Channel Units	String[30]	30	
Volt Offset	Single (4 byte)	4	
Conversion Factor	Single (4 byte)	4	
Calibration Factor	Single (4 byte)	4	
High Alarm On	Boolean	1	
Low Alarm On	Boolean	1	
High Alarm Level	Single (4 byte)	4	
Low Alarm Level	Single (4 byte)	4	
High Alarm Dead band	Single (4 byte)	4	
Low Alarm Dead band	Single (4 byte)	4	
H Level Volts	Double (8 byte)	8	
L Level Volts	Double (8 byte)	8	
H Band Volts	Double (8 byte)	8	
L Band Volts	Double (8 byte)	8	
Gain	Byte	1	
Channel Colour	Integer (4 byte)	4	
Total Bytes for Each Channel (x 300 channels)		130	
Sample Rate	Double (8 byte)	8	0.0001
Voltage_Factor	Single (4 byte)	4	0.004883
Integer_Offset	Small Integer (2 byte)	2	2048

The data for each channel is calculated as:

$$\text{Volts} = \left[(\text{Bits} - \text{Integer_Offset}) \times \text{Voltage_Factor} - \text{Volt_Offset}_{\text{channel}} \right]$$

$$\text{Reading}_{\text{mechanical units}} = \text{Volts} * \text{Conversion_Factor}_{\text{channel}} - \text{CalibrationFactor}_{\text{channel}}$$

Data Acquisition FILE FORMATS - Acela Brake Test - June 15, 2005

During each data acquisition run, June 16 - 18, 2005, 3 files will be generated.

1) Principal Data File, 3000 Sampling Rate: xxxxxxxx.ab3

Binary Integer File, Intel format, integers in the range -32768 to +32768, containing:

- a) Header record, 2 integers (4 bytes, 2 bytes/integer), followed by
- b) Sequential records of integer data, 65 integers/record (2 bytes/integer, 130 bytes/record)
 - Record 2: 65 integers (130 bytes); channels 1 - 65 and speed, at time t=0 seconds
 - Record 3: 65 integers (130 bytes); channels 1 - 65 and speed, at time t=1/3000th seconds
 - Record 4: 65 integers (130 bytes); channels 1 - 65 and speed, at time t=2/3000th seconds
 - ... etc.

Nominal Sampling Rate = 3000 samples/second

Nominal Time between Samples = 0.00033 seconds

Principal Data File ".ab3" HEADER RECORD - 4 bytes total					
Byte Nos	Type	Parameter	Units	Nominal Value	No of Bytes
1 - 2	1 integer	no of columns (channels) per data record		65	2
3 - 4	1 integer	sample rate	samples/s	3000	2
Total					4

Principal Data File ".ab3" RECORD - 65 integers (130 bytes)					
Chan	Parameter	Axle	File Scale Factor [actuals in .Cal file]	Units	File Offset [actuals in .Cal file]
1	Lateral Acceleration, axle mounted	1	100	g	0
2	Lateral Acceleration, Truck Frame Left	1	100	g	0
3	Vertical Acceleration, Truck Frame Left	1	100	g	0
4	Longitudinal Acceleration, Truck Frame Left	1	100	g	0
5	Lateral Acceleration, Brake Mounting Tube	1	100	g	0
6	Vertical Acceleration, Brake Mounting Tube	1	100	g	0
7	Sine wave from resolver	1	1000		0
8	Sine wave from resolver	2	1000		0
9	Longitudinal Acceleration, Brake Mounting Tube	1	100	g	0
10	Lateral Acceleration, center caliper, near actuator	1	100	g	0
11	Vertical Acceleration, center caliper, near actuator	1	100	g	0
12	Longitudinal Accel, center caliper, near actuator	1	100	g	0
13	Brake Cylinder Pressure, center caliper	1	100	psi	0

14	Thermocouple, center rotor	1	10	deg F	0
15	File Synchronization signal		1000		0
16	Lateral Acceleration, axle mounted	2	100	g	0
17	Lateral Acceleration, Truck Frame Left	2	100	g	0
18	Vertical Acceleration, Truck Frame Left	2	100	g	0
19	Longitudinal Acceleration, Truck Frame Left	2	100	g	0
20	Lateral Acceleration, Brake Mounting Tube	2	100	g	0
21	Vertical Acceleration, Brake Mounting Tube	2	100	g	0
22	Longitudinal Acceleration, Brake Mounting Tube	2	100	g	0
23	Lateral Acceleration, center caliper, near actuator	2	100	g	0
24	Vertical Acceleration, center caliper, near actuator	2	100	g	0
25	Longitudinal Accel, center caliper, near actuator	2	100	g	0
26	Thermocouple, center rotor	2	10	deg F	0
27	Brake Cylinder Pressure, center caliper	2	100	psi	0
28	Strain gage, center disc spoke 6, F1	1	1	uE	0
29	Strain gage, center disc spoke 6, F2	1	1	uE	0
30	Strain gage, center disc spoke 6, R1	1	1	uE	0
31	Strain gage, center disc spoke 6, R2	1	1	uE	0
32	Bad channel, unused		1		0
33	Strain gage, center disc spoke 3, R1	1	1	uE	0
34	Strain gage, center disc spoke 3, R2	1	1	uE	0
35	Strain gage, axle near center disc adjacent spoke 6	1	1	uE	0
36	Strain gage, axle near center disc adjacent spoke 3	1	1	uE	0
37	Strain gage, axle near ¼ location, adjacent spoke 6	1	1	uE	0
38	Strain gage, axle near ¼ location, adjacent spoke 3	1	1	uE	0
39	Strain gage, center caliper left	1	1	uE	0
40	Strain gage, center caliper right	1	1	uE	0
41	Strain gage, center disc spoke 6, R1 (SG1)	2	1	uE	0

42	Strain gage, center disc spoke 6, R2 (SG2)	2	1	uE	0
43	Strain gage, center disc spoke 3, R1 (SG3)	2	1	uE	0
44	Strain gage, center disc spoke 3, R2 (SG3a)	2	1	uE	0
45	Strain gage, center disc spoke 6 face, upper gage (SG4)	2	1	uE	0
46	Strain gage, center disc spoke 6 face, lower gage (SG5)	2	1	uE	0
47	Strain gage, center disc spoke 4, R2 position (SG6)	2	1	uE	0
48	Strain gage, axle near center disc adjacent spoke 6	2	1	uE	0
49	Strain gage, axle near center disc adjacent spoke 3	2	1	uE	0
50	Strain gage, axle near ¼ location, adjacent spoke 6	2	1	uE	0
51	Strain gage, axle near ¼ location, adjacent spoke 3	2	1	uE	0
52	Strain gage, axle near center disc adjacent spoke 6 + 90°	2	1	uE	0
53	Strain gage, axle near center disc adjacent spoke 6 - 90°	2	1	uE	0
54	Lateral Acceleration, Axle Box left	1	100	g	0
55	Vertical Acceleration, Axle Box left	1	100	g	0
56	Lateral Acceleration, Axle Box right	1	100	g	0
57	Vertical Acceleration, Axle Box right	1	100	g	0
58	Lateral Acceleration, Axle Box left	2	100	g	0
59	Vertical Acceleration, Axle Box left	2	100	g	0
60	Lateral Acceleration, Axle Box right	2	100	g	0
61	Vertical Acceleration, Axle Box right	2	100	g	0
62	Lateral Acceleration 2, axle mounted	1	100	g	0
63	Lateral Acceleration 3, axle mounted	1	100	g	0
64	Longitudinal Acceleration, axle mounted	1	100	g	0
65	Calculated Speed for SINE 1		100	mph	0

Note: Each data integer stored in the .ab3 file must be divided by the respective file scale factor to obtain correct engineering units. i.e. Physical data value (engineering units) = integer / file scale factor - offset

2) GPS Data File: xxxxxxxx.gps

Ascii File, containing:

- a) Sequential records of data, Ascii format, 6 columns, space delimited, and trailing text giving location w.r.t. milepost, nominally 72 characters/record (1 byte/character, ~72 bytes/record)
 Record 1: ~72 characters (41 bytes); gps data at time t=0 second
 Record 2: ~72 characters (41 bytes); gps data at time t=1 second
 ... etc.

Sampling Rate = 1 sample/second

GPS Data File Format - Space Delimited			
Column	Parameter	Units	Nominal No. of Characters
1	GPS time, seconds past midnight Greenwich	sec	6
2	Latitude	deg	12
3	Longitude	deg	13
4	Speed	mph	6
5	No. of Satellites		4
6	Corresponding time in the .AB2 data file	sec	6
7	Text giving location with respect to Milepost		25

3) Calibration File: xxxxxxxx.cal

Ascii File, containing:

- a) 1 record for each data channel (total of 65), Ascii format, 5 columns, space delimited

Column	Parameter	Units	Nominal No. of Characters
1	Sensor offset - required only for documentation	V	11
2	Sensor gain – required only for documentation	e.g. mV/g	11
3	File Scale Factor - necessary to convert file data to engineering units		8
4	File Offset - necessary to convert file data to engineering units		8
5	Channel description and units		~ 24

Note: Each data integer stored in the .ab3 file must be divided by the respective file scale factor to obtain correct engineering units. i.e. Physical data value (engineering units) = integer / file scale factor - offset

