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SAFETY COMPLIANCE TESTING FOR

FMVSS No. 122: MOTORCYCLE BRAKE SYSTEMS

Test Vehicle: 2002 HONDA FSC600 SILVERWING

NHTSA No. C21201

Manufacturer: Honda Motor Company, Ltd.

Report No. 122-CE-03-002

CARTER ENGINEERING
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Franklin, Tennessee 37064

MAY 2003
FINAL REPORT

Prepared for

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6115 (NVS-220)
Washington, DC 20590

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16. Abstract

Compliance tests were conducted on the subject 2002 Honda FSC600 Silverwing motorcycle in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-122-01 for the determination of Federal Motor Vehicle Safety Standard 122 compliance. Test failures identified were as follows:

None.

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1.0 Purpose

The purpose of this test program was to determine compliance of the subject motorcycle brake system by subjecting it to the tests of Federal Motor Vehicle Safety Standard (FMVSS) No. 122.

2.0 Definitions

2.1 Initial Speed or Test Speed — The travel speed of the motorcycle at the moment either brake is applied.

2.2 Brake Application — The initial movement of the brake system control pedal and/or lever.

2.3 Braking Interval — The distance measured from the start of one brake application to the start of the next brake application.

2.4 Initial Brake Temperature (IBT) — The temperature of the service brake at 0.32 km (0.2 mile) before a stop with the brakes released.

2.5 Stopping Distance — The distance traveled by a vehicle from the start of the brake application to the point where the vehicle stops.

2.6 Curb Weight — The total weight of the motorcycle with standard equipment including the maximum capacity of fuel, lubricants, and coolant, but without operator, passenger, instrumentation, or cargo.

2.7 Basic Test Weight - The total weight of the motorcycle with standard equipment, the maximum capacity of fuel, lubricants, and coolant, and test instrumentation. Weight is without operator, passenger, or additional cargo.

2.8 Test Weight — The total as-tested weight of the motorcycle including test instrumentation and operator.

2.9 Lightly Loaded Vehicle Test Weight (LLVW) — Curb Weight plus 91 kg (200 lb). The 91 kg (200 lb) load includes test instrumentation and operator. If the combined operator and instrumentation weight total is less than 91 kg (200 lb), ballast shall be added to achieve the proper loading. Any ballast added shall be distributed in the saddle or carrier if so equipped.

2.10 Wheel Lockup — Wheel lockup means 100 percent wheel slip.

2.11 Independent Braking System

2.11.1 FOR TWO-WHEELED MOTORCYCLE — A system which acts on only one wheel.

2.12 Combined Braking System

2.12.1 FOR TWO-WHEELED MOTORCYCLE — A system whereby at least two brakes on different wheels are actuated by the operation of a single control.

2.13 Hydraulic Brake System - A system that uses hydraulic fluid as a medium for transmitting forces from a service brake control to the service brake.

2.14 Mechanical Brake System— A system that uses direct mechanical connections such as push/pull rods, cables, linkages, etc for transmitting forces from a service brake control to the service brake.

2.15 Maximum Speed (V_{max}) — For the purpose of FMVSS No. 122 brake testing, the maximum speed is the highest speed attainable by accelerating at a maximum rate from a standing start for a distance 1.6 km (1 mile) on a level surface, with the vehicle at its lightly loaded weight.

2.16 Braking Ratio (BR) — The braking ratio is the average deceleration rate of the vehicle divided by the gravitational acceleration constant.

2.17 Average Deceleration Rate — The average deceleration rate during the stop is calculated using initial speed and stopping distance. The following equation is used to calculate average deceleration:

$$a = \frac{V^2}{2d}$$

Where:

a = average deceleration rate (m/s^2)
V = velocity (m/s)
d = stopping distance (m)

2.18 Swept Area — The swept area of a disk brake is the total area contacted by both inboard and outboard brake pads in one revolution, i.e., the area on both sides of the rotor rubbed by the pads. The swept area of a drum brake is the inside drum circumference multiplied by the brake lining width.

2.19 Split Service Brake System — A brake system consisting of two or more subsystems actuated by a single control designed so that a leakage-type failure of a pressure component in a single subsystem (except structural failure of a housing that is common to two or more subsystems) does not impair the operation of any other subsystem.

2.20 Motorcycle — A motor vehicle with motive power having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground.

2.21 Motor-Driven Cycle — A motorcycle with a motor that produces 5 brake horsepower or less.

3.0 Government Furnished Property

3.1 General Description

NHTSA Number	C21201
Manufacturer	Honda Motor Company, Ltd.
Year	2002
Model	FSC600
Date of Manufacture	December 2001
VIN	JH2PF011X2K001403
Engine Type	Twin Cylinder, Four-stroke, Liquid-cooled, DOHC
Engine Displacement	582 cm^3
Fuel Delivery	Fuel Injection
Transmission	Automatic
Final Drive	Belt
Wheelbase	1595 mm

3.2 Tires

	Front	**Rear**
Manufacturer	IRC	IRC
Type	SS-530F – Tubeless	SS-530R – Tubeless
Size	120/80 – 14 M/C 58S	150/70 – 13 M/C 64S
DOT Number	DOT CJCM HFN 4901	DOT CJCN HBN 3802
Pressure (cold)	200 kPa	225 kPa
Rim Label Information	Honda 71S J 14 m/c x MT 2.75 DOT YSK Hytec Tubeless Tire Applicable	Honda 72S J 13 m/c x MT 4.50 DOT YSK Hytec Tubeless Tire Applicable

3.3 Weights

	Front Wheel		Rear Wheel		Total
	Weight(kg)	% of Total	Weight(kg)	% of Total	Weight(kg)
Curb Weight	94.3	38.8	148.8	61.2	243.1
Curb Weight+Rider	127.0	39.1	197.8	60.9	324.8
Basic Test Weight	96.2	37.9	157.8	62.1	254.0
Test Weight	132.5	39.5	203.2	60.5	335.7
Instrumentation					10.9
Test Rider					81.7
Total Load (Weight of Instrumentation + Weight of Test Rider)					92.6
Maximum Load Capacity					166

3.4 Brakes

	Front	Rear
System Type	Disk/Hydraulic/Independent/ Non-ABS	Disk/Hydraulic/Combined/ Non-ABS
Control	Right hand lever actuates front wheel brake	Left hand lever actuates both rear & front wheel brakes[1]
Caliper Type	Single Acting	Single Acting
Number of Calipers	1	1
No. of Caliper Pistons/Equal Dia.?	3 / No	2 / Yes
Caliper Piston Diameters	27/23/27 mm	27/27 mm
Rotor – Type/Number	Fixed/Single	Fixed/Single
Drilled?/Number of Holes/Hole Dia.	Yes / 40 / 8.5 mm	Yes / 32 / 8.5 mm
Rotor Diameter	256 mm	240 mm
Rotor Thickness/Minimum Allowable Thickness	5.0 mm / 4.0 mm	6.0 mm / 5.0 mm
Rotor Effective Diameter	223 mm	210 mm
Swept Area	438 cm^2	398 cm^2
Brake Pad Identification Numbers	Nissin - TOYO S20A1HH	Nissin TT2506HH
Brake Lever/Pedal Ratio @FMVSS Point	5	5

[1] Temporary exemption No. EX2001-8.

3.5 Receiving Inspection of the Test Motorcycle

As-Received odometer reading	82 miles
Operator Manual received?	Yes
Service Manual received?	No
Speedometer display	U.S. + Metric
Mechanical condition	New
Mechanical condition adequate to complete test procedure?	Yes
Are brake hoses labeled per FMVSS 106?	Yes
Tire Condition @ Start of Test	New
Are brake components in new OEM Condition?	Yes

4.0 Method

The tests of FMVSS No. 122 involve straight line braking from various speeds, brake burnishing, fade and recovery, and wet brake fade and recovery. All tests were performed by an experienced rider. FMVSS No. 122 requires stops from near maximum speed, however, for this test program NHTSA has limited the maximum test speed to 80 mph (128.7 km/h).

4.1 Test Facility

Testing was conducted at the Tullahoma Regional Airport in Tullahoma, Tennessee. The layout of the airport is shown in Figure 1. The inactive Northwest-Southeast runway was used for this test program. A total straightaway distance of approximately 1.77 km (1.1 mile) was available by crossing the two active runways. Airport authority coordination was required to cross active runways and this option was used only for maximum speed test runs. For the maximum speed runs, the airport manager was notified by the test engineer and the test runs were conducted per the airport manager's instructions. The concrete surface is substantially level (less than ±1% gradient), in good condition, and affords good adhesion. The runways are 45.7 m (150 ft) wide. The airport altitude is approximately 330.7 m (1085 ft) above sea level.

4.2 Test Facility Layout

For each test procedure, traffic cones are set up to indicate the initial temperature record point, brake application point, target stop distances, and cool down distance if required. The layouts were altered as required to accommodate airport traffic and runway/taxiway use restrictions.

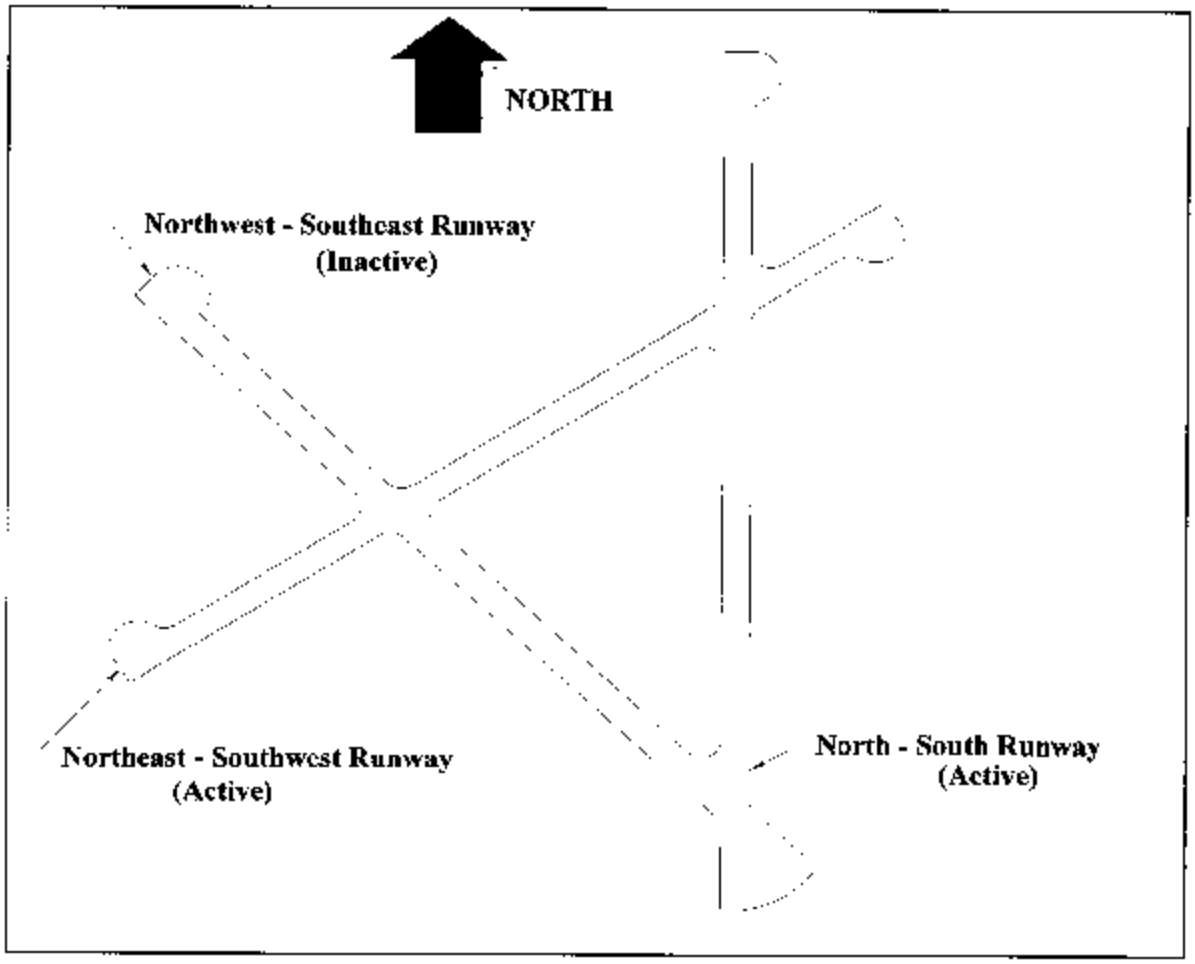


Figure 1. Layout of Tullahoma Regional Airport

4.3 Instrumentation

A lightweight instrumentation package was used for data acquisition during this program. The package included a data recorder, multiplexer, power supplies, and sensors. The following sensors were fitted to the test motorcycle:

- A third wheel to measure distance.
- Actuation forces were measured by strain gages fitted to the front and rear hand brake levers.
- Thermocouples were installed in the front and rear brake linings to measure brake temperatures.

The digital data recorder and multiplexer were used to record brake forces and distance versus time. Speed and deceleration were calculated from the distance versus time data. A handlebar mounted push button switch activated the initial temperature recording function and started the data recording. Application of either the front or rear brake marked the beginning of the stop. The data recorder acquired data until the motorcycle

stopped. A test data summary was displayed at the end of each stop. A description of the instrumentation system is provided in the Contractor Test Procedure for FMVSS No. 122 - Motorcycle Brake Systems, November, 2002. The instrumentation list is provided in Appendix 1 and the brake hand lever and pedal calibration curves are in Appendix 2.

4.4 Preparation of the Test Motorcycle

Refer to Contractor Test Procedure for FMVSS No. 122 - Motorcycle Brake Systems, November, 2002, Thomas J. Carter, Carter Engineering.

4.5 Test Procedure

Refer to Contractor Test Procedure for FMVSS No. 122 - Motorcycle Brake Systems, November, 2002, Thomas J. Carter, Carter Engineering.

5.0 Data Sheets

5. Data Sheet No. 1 – Test Summary

Test Vehicle: **NHTSA C21201**							Test Date(s): **3/14/03 & 4/3/03**
Test runs selected for compliance.							
Test Section	Speed (km/h)	BR[2]	Stop Dist. (m)	Max. Brake Lever Force (N)	Max. Brake Pedal Force (N)	No. of Tests	Pass or Fail?
1st Effectiveness Test 48.3 km/h (Service Brake System)	48.3	0.81	11.3	72	75	6	PASS
1st Effectiveness Test – 96.6 km/h (Service Brake System)	96.5	0.81	45.0	122	103	6	PASS
1st Effectiveness Test - 48.3 km/h (Partial - Right Hand Lever Only)	48.3	0.64	14.3	139	N/A	6	PASS
1st Effectiveness Test - 48.3 km/h (Partial - Left Hand Lever Only)	48.3	0.59	15.4	N/A	149	6	PASS
1st Effectiveness Test – 96.6 km/h (Partial - Right Hand Lever Only)	96.5	0.69	53.1	140	N/A	6	PASS
1st Effectiveness Test 96.6 km/h (Partial - Left Hand Lever Only)	96.2	0.62	58.5	N/A	145	6	PASS
2nd Effectiveness Test - 48.3 km/h (Service Brake System)	48.3	0.78	11.7	74	61	6	PASS
2nd Effectiveness Test – 96.6 km/h (Service Brake System)	96.5	0.80	45.9	136	57	6	PASS
2nd Effectiveness Test – 128.7 km/h (Service Brake System)	128.7	0.70	92.9	100	49	4	PASS
Fade and Recovery (Baseline – Average Maximum Forces)	N/A	N/A	N/A	32.3	45.7	3	N\A
Fade and Recovery (Recovery – 5th stop)	47.8	0.32	28.0	27	37	5	PASS
Final Effectiveness Test - 48.3 km/h (Service Brake System)	48.1	0.76	12.0	148	28	6	PASS
Final Effectiveness Test – 96.6 km/h (Service Brake System)	96.0	0.72	50.1	131	93	6	PASS
Final Effectiveness Test – 128.7 km/h (Service Brake System)	128.3	0.79	81.6	131	46	4	PASS
Water Recovery (Baseline – Average Maximum Forces)	N/A	N/A	N/A	28	39	3	N\A
Water Recovery (Recovery – 5th stop)	48.5	0.31	29.6	22	41	5	PASS

Note: All testing and data recording was performed by the report author: Thomas J. Carter, P.E.

[2] BR - Braking Ratio The deceleration rate divided by the gravitational constant.

5. Data Sheet No. 2 – Vehicle Brake System Inspection

Test Vehicle: **NHTSA C21201**	Test Date(s): **12/15/02 & 12/16/02**		
Vehicle Brake System Inspection Requirements	**Test Vehicle Compliance**	**Data**	
		Yes	**No**
S5.1 - Motorcycle shall have either a split service brake system or two independently actuated service brake systems.	Motorcycle has split service brake system?		X
	Motorcycle has two independently actuated service brake systems?	X	
S5.1.1 - Failure of any component in a mechanical service brake system shall not result in a loss of braking ability in the other service brake system on the vehicle.	If vehicle has a mechanical service brake system, would component failure result in loss of braking in other service brake system?	N/A	N/A
S5.1.2 - Leakage failure in hydraulic service brake system shall not result in a loss of braking ability in other service brake system on the vehicle.	If vehicle has hydraulic service brake system, would leakage failure in one service brake system result in a loss of braking ability in other service brake system?		X
S5.1.2.1 - Each master cylinder shall have a separate reservoir for each brake circuit, with each reservoir filler opening having its own cover, seal, and cover retention device. Each reservoir shall have a minimum capacity equivalent to one and one-half times the total fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir move from a new lining, fully retracted position to a fully worn, fully applied position. Where adjustment is a factor, the worst condition of adjustment shall be used for this measurement. (See Appendix 3 for information on reservoir capacity measurement)	Vehicle meets master cylinder reservoir requirements? Front Service Brake System	X	
	Vehicle meets master cylinder reservoir requirements? Rear Service Brake System	X	
S5.1.2.2 - Each motorcycle shall have a brake fluid warning statement that reads as follows, in letters at least three thirty-seconds of an inch high: **Warning: clean filler cap before removing. Use only ---fluid from a sealed container.** (Inserting the recommended type of brake fluid as specified in 49 CFR 571.116, e.g., DOT 3.) The lettering shall be: (A) Permanently affixed, engraved, or embossed (B) Located so as to be visible by direct view, either on or within 4 inches of the brake-fluid reservoir filler plug or cap (C) Of a color that contrasts with its background, if it is not engraved or embossed	Vehicle meets master cylinder warning statement requirements? Front Service Brake System	X	
	Vehicle meets master cylinder warning statement requirements? Rear Service Brake System	X	
	Type of brake fluid required?	**DOT 4**	

5. Data Sheet No. 2 – Vehicle Brake System Inspection…Continued

Vehicle Brake System Inspection Requirements	Test Vehicle Compliance	Data	
		Yes	No
S5.1.3 - (A) Each motorcycle equipped with a split service brake system shall have one or more electrically operated service brake system failure indicator lamps that is mounted in front of and in clear view of the driver, and that is activated - - (1) In the event of pressure failure in any part of the service brake system, other than a structural failure of either a brake master cylinder body in a split integral body type master cylinder system or a service brake system failure indicator body, before or upon application of not more than 20 lb of pedal force upon the service brake. (2) Without the application of pedal force, when the level of brake fluid in a master cylinder reservoir drops to less than the recommended safe level specified by the manufacturer or to less than one-half the fluid reservoir capacity, whichever is the greater.	Does vehicle have a brake system failure indicator lamp?	N/A	N/A
(B) All failure indicator lamps shall be activated when the ignition switch is turned from the "off" to the "on" or to the "start" position (C) Except for the momentary activation required by S5.1.3.1(b), each indicator lamp once activated, shall remain activated as long as the condition exists, whenever the ignition switch is in the "on" position. An indicator lamp activated when the ignition is turned to the "start" position will be deactivated upon return of the switch to the "on" position unless a failure exists in the service brake system. (D) Each indicator lamp shall have a red lens with the legend "Brake Failure" on or adjacent to it in letters not less than three thirty-seconds of an inch high that shall be legible to the driver in daylight when lighted.	Does failure indicator lamp conform to operational and physical requirements?	N/A	N/A
S5.1.4 - Each three-wheeled motorcycle shall be equipped with a parking brake of a friction type with a solely mechanical means to retain engagement.	If vehicle is a three-wheeled motorcycle, is vehicle equipped with a parking brake?	N/A	N/A
S5.1.5 - The brake system shall be installed so that the lining thickness of the drum brake shoes may be visually inspected, either directly or by use of a mirror without removing the drums, and so that disc brake friction lining may be visually inspected without removing the pads.	Can the drum brake lining thickness or disc brake friction lining thickness be determined without removal of drum or disc brake pads? Front Service Brake System	X	
	Can the drum brake lining thickness or disc brake friction lining thickness be determined without removal of drum or disc brake pads? Rear Service Brake System	X	

5. Data Sheet No. 3 Instrumentation Check (S7.2)

Vehicle: **C21201**	Test Rider: **T.Carter**

Conduct a general check of test instrumentation by making not more than 10 stops from a speed of not more than 48.3 km/h (30 mph) at a deceleration of not more than 3 m/s^2 (10 ft/s^2). If test instrument repair, replacement, or adjustment is necessary, make not more than 10 additional stops after such repair, replacement or adjustment.

Date	Number of check stops.	Reason for check stops.
3/14/03	**6**	**Beginning of test day 1– check out/warm-up engine/tires - OK.**
4/3/03	**4**	**Beginning of test day 2 – check out/warm-up engine/tires - OK.**
4/5/03	**0**	**Post-test calibration check – OK.**

5. Data Sheet No. 3...Continued Maximum Speed Determination

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
N/A	C21201	T. Carter	N/A	N/A
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
N/A	N/A	N/A	200	225

Test Conditions:

Test speed	**Maximum speed (V_{max}) attainable in 1.6 km from a standing start.**
Initial Brake Temperature (IBT)	**N/A**
Runs Required	**At least two runs shall be made in opposite directions.**
Determine:	**Test speed for 2nd. & Final Effectiveness tests and/or Reduced Test Speed, as appropriate.**

Run No.	Run Dist (km)	Top Speed (km/h)
1	1.3+	N/A
2	1.3+	N/A
3	1.3+	N/A
4	1.3+	N/A
Average V_{max}:		N/A
Test Speed Or Reduced Test Speed[3]		N/A

Remarks: **No maximum speed runs were conducted – vehicle was capable of speeds equal to or greater than the 80 mph limit speed imposed by NHTSA.**

[3] Reduced Test Speed — If a motorcycle is incapable of attaining a specified test speed, it shall be tested at a speed that is a multiple of 5 mph that is 4 to 8 mph less than the motorcycle's maximum speed (V_{mpc}).

5. Data Sheet No. 4 First Preburnish Effectiveness Test – Service Brake System (S7.3.1)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
3/14/03	C21201	T. Carter	83	90
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
11.7°C	5 km/h from North	Full	200	225

Test Conditions – Compliance requires at least 1 stop within the limits listed below (Selected compliance run is underlined):

Test speed	48.3 km/h (30 mph)	96.6 km/h (60 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	6	6
Maximum Stop Distance Allowed	16.5 m (54 ft)	65.8 m (216 ft)
Minimum Braking Ratio (BR)	0.56	0.56
Maximum Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb)	Hand lever force ≤245 N (55 lb)

48.3 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)[4]	Max Rear Force (N)[5]	BR[6]	IBT °C			
						Frt[7]	Rr[8]		
1	49.9	15.4	51	63	0.64	54	53		
2	49.1	13.1	48	72	0.72	58	59		
3	48.3	11.3	72	75	0.81	60	60		
4	48.3	13.0	69	64	0.71	60	65		
5	46.4	11.4	80	70	0.75	64	65		
6	47.4	10.7	135	134	0.83	61	65		

[4]Maximum Front Brake Actuation Force (Newtons).
[5]Maximum Rear Brake Actuation Force (Newtons).
[6]Braking Ratio deceleration rate divided by gravitational constant.
[7]Front Initial Brake Temperature (°C).
[8]Rear Initial Brake Temperature(°C).

5. Data Sheet No. 4 First Preburnish Effectiveness Test – Service Brake Sys...Continued

96.6 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	95.7	45.1	107	85	0.80	64	66		
2	94.4	46.7	100	84	0.75	56	57		
3	96.5	45.0	122	103	0.81	58	55		
4	94.8	42.0	121	92	0.84	64	64		
5	94.6	43.5	133	118	0.81	56	61		
6	95.8	43.2	97	145	0.84	55	61		

5. Data Sheet No. 5 Preburnish Partial Service Brake System Effectiveness Test (S7.3.2)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
3/14/03	C21201	T. Carter	90	104
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
11.7°C	6 km/h from Northeast	>3/4	200	225

Test Conditions – For a motorcycle with two independently actuated service brake systems, test each service brake system individually. Compliance requires at least 1 stop within the limits listed below (Selected compliance run is underlined):

Test speed	48.3 km/h (30 mph)	96.6 km/h (60 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	6	6
Maximum Stop Distance Allowed	36.9m (121 ft)	147.5m (484 ft)
Minimum Braking Ratio (BR)	0.25	0.25
Max Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb)	Hand lever force ≤245 N (55 lb)
Brake System & Operator Input Control	Partial Service Brake System #1 – Right Hand Lever	

Test speed	48.3 km/h (30 mph)	96.6 km/h (60 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	6	6
Maximum Stop Distance Allowed	36.9m (121 ft)	147.5m (484 ft)
Minimum Braking Ratio (BR)	0.25	0.25
Max Allowable Brake Actuation Forces	Hand lever force <245 N (55 lb)	Hand lever force ≤245 N (55 lb)
Brake System & Operator Input Control	Partial Service Brake System #2 – Left Hand Lever	

48.3 km/h Data: Brake System 1 - Right hand lever operated front brake system

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	47.6	17.7	124	N/A	0.50	57	N/A
2	48.1	14.8	143	N/A	0.61	55	N/A
3	49.0	14.6	145	N/A	0.65	56	N/A
4	49.0	14.3	132	N/A	0.66	57	N/A
5	48.5	13.5	158	N/A	0.68	58	N/A
6	48.3	14.3	139	N/A	0.64	56	N/A

5. Data Sheet No. 5 Preburnish Partial Service Brake System Effectiveness...Continued

48.3 km/h Data: **Brake System 2 - Left hand lever operated rear brake system**

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	48.7	15.8	N/A	139	0.59	N/A	56
2	48.3	15.4	N/A	149	0.59	N/A	61
3	47.8	16.3	N/A	145	0.55	N/A	60
4	47.8	15.0	N/A	140	0.60	N/A	61
5	47.6	15.6	N/A	140	0.57	N/A	66
6	49.2	15.6	N/A	127	0.61	N/A	63

96.6 km/h Data: **Brake System 1 - Right hand lever operated front brake system**

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	96.1	56.6	130	N/A	0.64	61	N/A
2	94.1	52.0	138	N/A	0.67	57	N/A
3	94.7	53.9	124	N/A	0.65	58	N/A
4	96.0	54.6	130	N/A	0.66	55	N/A
5	93.9	52.9	143	N/A	0.66	63	N/A
6	96.5	53.1	140	N/A	0.69	57	N/A

96.6 km/h Data: **Brake System 2 - Left hand lever operated rear brake system**

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	95.5	58.6	N/A	112	0.61	N/A	62
2	96.9	62.7	N/A	129	0.59	N/A	65
3	95.0	58.2	N/A	143	0.61	N/A	64
4	96.2	58.5	N/A	145	0.62	N/A	65
5	96.7	58.5	N/A	160	0.63	N/A	57
6	95.4	66.9	N/A	124	0.54	N/A	62

5. Data Sheet No. 6 First Burnish Procedure (S7.4)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
3/14/03	C21201	T. Carter	104	136
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
10°C	N/A	N/A	200	225

Test Conditions:

Test speed	**48.3 km/h (30 mph)**
Initial Brake Temperature (IBT) between	**54°C (130°F) and 66°C (150°F)**
Number of Stops Performed	**200**
Deceleration Rate	**3.7 m/s^2 (12 ft/s^2) - The equivalent braking ratio is 0.377**
Actuation Forces	**Hand lever and foot pedal force limits do not apply during this procedure**
Cooling Speed	**Accelerate at maximum rate to 48.3 km/h immediately and maintain that speed until making the next stop.**
Stop Interval	**The braking interval shall be either the distance necessary to cool brakes to the IBT or one mile, whichever comes first.**
Post Burnish Adjustments	**After burnishing adjust the brakes in accordance with the manufacturer's recommendation.**

Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	48.4	25.7	27	42	0.36	55			
25	48.5	24.8	29	43	0.37	65			
50	48.5	24.5	24	41	0.38	62			
75	47.8	24.1	28	60	0.37	58			
100	49.1	25.5	25	43	0.37	62			
125	48.3	24.2	37	46	0.38	54			
150	48.5	24.9	32	56	0.37	60			
175	48.5	26.0	23	58	0.36	57			
200	47.3	24.1	29	42	0.37	59			

5. Data Sheet No. 7 Second Effectiveness Test – Service Brake System (S7.5)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
4/3/03	C21201	T. Carter	136	151
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
18.3°C	11 km/h from Southwest	Full	200	225

Test Conditions – Compliance requires at least 1 stop within the limits listed below (Selected compliance run is underlined):

Test speed	48.3 km/h (30 mph)	96.6 km/h (60 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	6	6
Maximum Stop Distance Allowed	13.1 m (43 ft)	56.4 m (185 ft)
Minimum Braking Ratio (BR)	0.70	0.65
Maximum Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb)	Hand lever force ≤245 N (55 lb)

Test speed	128.7 km/h (80 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	4
Maximum Stop Distance Allowed	105.2 m (345 ft)
Minimum Braking Ratio (BR)	0.62
Maximum Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb)

48.3 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	48.4	10.7	57	82	0.86	55	58		
2	47.7	12.1	103	53	0.74	58	58		
3	48.0	14.9	96	71	0.61	63	58		
4	48.8	11.9	104	66	0.78	59	60		
5	48.3	11.7	74	61	0.78	64	60		
6	47.6	11.3	132	51	0.79	66	66		

5. Data Sheet No. 7 Second Effectiveness Test – Service Brake System…Continued

96.6 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	96.2	46.2	109	58	0.79	65	62
2	93.6	44.1	118	44	0.78	63	66
3	96.5	45.9	136	57	0.80	60	65
4	96.0	46.2	130	47	0.78	65	65
5	97.6	46.9	140	56	0.80	64	61
6	96.9	46.4	139	58	0.80	60	61

128.7 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	129.1	88.2	97	45	0.74	63	58
2	126.7	89.7	96	82	0.70	59	60
3	123.0	79.3	134	64	0.75	56	57
4	128.7	92.9	100	49	0.70	55	57

5. Data Sheet No. 8 Fade and Recovery Test – Service Brake System (S7.6)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
4/3/03	C21201	T. Carter	151	167
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
18.9°C	12 km/h from Southwest	Full	200	225

This test consists of 3 sections: Baseline Check Stops (S7.6.1), Fade Stops (S7.6.2) and Recovery Stops (S7.6.3). The purpose of the Baseline Check Stops section is to determine the allowable brake actuation force limits for the fifth recovery stop. The Baseline Check Stops are performed first. Compliance requires that the fifth recovery stop brake actuation forces are within the computed limits.

Test Conditions – Baseline Check Stops:

Test speed	48.3 km/h (30 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	3
Deceleration Rate	3.04 to 3.33 m/s^2 (10 to 11 ft/s^2) – The equivalent braking ratio is 0.31 to 0.34.
Maximum Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb)

48.3 km/h Baseline Check Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	48.7	29.6	31	54	0.31	56	60		
2	49.0	28.6	30	39	0.33	56	61		
3	48.5	28.3	36	44	0.33	61	64		
Average Max Actuation Force (to be used in computing 5th recovery stop actuation force limits)			32.3	45.7					

5. Data Sheet No. 8 Fade and Recovery Test – Service Brake System…Continued

Test Conditions – Fade Stops:

Test speed	**96.6 km/h (60 mph)**
First Stop – Initial Brake Temperature (IBT) between	**54°C (130°F) and 66°C (150°F)**
IBT – Subsequent Stops	**IBT prior to brake applications for subsequent stops shall be those occurring at the distance intervals**
Number of Stops Performed	**10 – Accelerate as rapidly as possible to the test speed immediately after each stop. Maintain test speed until the next brake application.**
Minimum Braking Ratio (BR)	**0.47**
Stop Interval	**644 m (2112 ft)**
Maximum Allowable Brake Actuation Forces	**Hand lever force ≤245 N (55 lb)**
Post-Fade Test Procedure	**After the 10th fade stop, drive 1.6 km (1 mile) at 48.3 km/h (30 mph) and immediately conduct the recovery test.**

Data - Fade Stops:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	96.4	74.8	42	46	0.49	63	63		
2	95.4	66.1	50	49	0.54	130	102		
3	97.1	67.1	43	48	0.55	162	127		
4	96.7	63.0	45	54	0.58	186	153		
5	96.7	65.5	40	62	0.56	192	168		
6	95.8	66.9	52	42	0.54	203	180		
7	98.2	68.7	49	47	0.55	198	182		
8	97.5	63.2	50	47	0.59	206	183		
9	98.3	67.5	49	53	0.56	200	186		
10	97.5	66.3	50	59	0.56	207	193		

5. Data Sheet No. 8 Fade and Recovery Test – Service Brake System…Continued

Test Conditions – Recovery Stops:

Test speed	**48.3 km/h (30 mph)**
First Stop – Initial Brake Temperature (IBT) between	**Temperature achieved at completion of fade stop procedure.**
IBT – Subsequent Stops	**IBT prior to brake applications for subsequent stops shall be those occurring at the distance intervals.**
Number of Stops Performed	**5 – Accelerate as rapidly as possible to the test speed immediately after each stop. Maintain test speed until the next brake application.**
Deceleration Rate	**3.04 to 3.33 m/s^2 (10 to 11 ft/s^2) – The equivalent braking ratio is 0.31 to 0.34.**
Stop Interval	**≤ 1.6 km (1 mile)**
Maximum Allowable Brake Actuation Forces – Stops 1 through 4	**Hand lever force ≤245 N (55 lb)**
Maximum Allowable Brake Actuation Forces – Stop 5	**See 5th Recovery Stop Actuation Force Limit Computation Table below.**

5th Recovery Stop Actuation Force Limit Computations (S5.4.3)			
Service Brake 1 (Front Brake)		Service Brake 2 (Rear Brake)	
Lower Limit Average Max Force (**32.3 N**) minus 44.5 N	Upper Limit – Average Max Force (**32.3 N**) plus 89 N	Lower Limit – Average Max Force (**45.7 N**) minus 44.5 N	Upper Limit Average Max Force (**45.7 N**) plus 89 N
0	**121.3**	**1.2**	**134.7**

48.3 km/h Recovery Stop Data (Selected compliance run is underlined):

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	**48.5**	**28.6**	**24**	**39**	**0.32**	**200**	**201**		
2	**48.7**	**29.1**	**28**	**36**	**0.32**	**94**	**122**		
3	**48.0**	**28.2**	**29**	**34**	**0.32**	**64**	**94**		
4	**49.7**	**28.9**	**29**	**34**	**0.34**	**54**	**78**		
5	**47.8**	**28.0**	**27**	**37**	**0.32**	**54**	**80**		

5. Data Sheet No. 9 Second Burnish Procedure (S7.7)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
4/3/03	**C21201**	**T. Carter**	**167**	**183**
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
21.1°C	**9 km/h from Southwest**	**Full**	**200**	**225**

Test Conditions:

Test speed	**48.3 km/h (30 mph)**
Initial Brake Temperature (IBT) between	**54°C (130°F) and 66°C (150°F)**
Number of Stops Performed	**35**
Deceleration Rate	**3.7 m/s^2 (12 ft/s^2) - The equivalent braking ratio is 0.377**
Actuation Forces	**Hand lever and foot pedal force limits do not apply during this procedure**
Cooling Speed	**Accelerate immediately at maximum rate to 48.3 km/h and maintain that speed until making the next stop.**
Stop Interval	**The braking interval shall be either the distance necessary to cool brakes to the IBT or one mile, whichever comes first.**
Post Burnish Adjustments	**The brakes may be adjusted in accordance with the manufacturer's recommendation if no tools are required for the procedure.**

Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	**48.7**	**25.0**	**27**	**38**	**0.37**	**62**	**65**		
2	**48.0**	**24.7**	**30**	**47**	**0.37**	**62**	**66**		
3	**48.0**	**24.8**	**30**	**40**	**0.37**	**63**	**65**		

5. Data Sheet No. 10 Final Effectiveness Test – Service Brake System (S7.8.1)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
4/3/03	**C21201**	**T. Carter**	**183**	**196**
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
21.7°C	**12 km/h from Southwest**	**>3/4**	**200**	**225**

Test Conditions – Compliance requires at least 1 stop within the limits listed below (Selected compliance run is underlined):

Test speed	48.3 km/h (30 mph)	96.6 km/h (60 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	6	6
Maximum Stop Distance Allowed	13.1 m (43 ft)	56.4 m (185 ft)
Minimum Braking Ratio (BR)	0.70	0.65
Maximum Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb)	Hand lever force ≤245 N (55 lb)

Test speed	128.7 km/h (80 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	4
Maximum Stop Distance Allowed	105.2 m (345 ft)
Minimum Braking Ratio (BR)	0.62
Maximum Allowable Brake Actuation Forces	Hand lever force <245 N (55 lb)

48.3 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C	
						Frt	Rr
1	49.1	12.1	133	64	0.78	63	59
2	48.0	11.9	145	29	0.76	61	59
3	49.2	12.1	144	36	0.78	66	65
4	48.1	12.0	148	28	0.76	65	65
5	49.4	12.0	135	25	0.80	62	62
6	49.0	11.5	143	54	0.82	55	56

5. Data Sheet No. 10 Final Effectiveness Test – Service Brake System…Continued

96.6 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	94.6	46.9	82	63	0.75	58	59		
2	98.1	45.6	133	41	0.83	63	64		
3	98.5	50.0	107	49	0.76	65	65		
4	95.5	50.9	160	36	0.71	64	64		
5	96.0	50.1	131	93	0.72	65	64		
6	95.0	46.2	155	35	0.77	60	65		

128.7 km/h Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	128.3	81.6	131	46	0.79	63	62		
2	132.1	86.8	135	35	0.79	60	64		
3	129.1	95.6	78	47	0.69	56	55		
4	130.5	91.7	126	35	0.73	60	66		

5. Data Sheet No. 11 Partial Service Brake System – Split Service Brake Systems (S7.8.2)

Date:	Vehicle:	Test Rider:	Odometer Reading - mi	
			Start:	Finish:
N/A	N/A	N/A	N/A	N/A
Ambient Temperature	Wind Velocity/Direction:	Fuel Level.	Tire Pressure (cold) - kPa	
			Front	Rear
N/A	N/A	N/A	N/A	N/A

Test Conditions – Alter the service brake system on three-wheeled motorcycles to induce a complete loss of braking in any one subsystem. Determine line pressure or pedal/lever force required to cause operation of the brake system failure indicator. Utilize the brake system not disabled and repeat procedure with each brake subsystem. Compliance requires at least 1 stop within the limits listed below (Selected compliance run is underlined):

Test speed	48.3 km/h (30 mph)	96.6 km/h (60 mph)
Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	54°C (130°F) and 66°C (150°F)
Number of Stops Performed	6	6
Maximum Stop Distance Allowed	29.6m(97 ft)	118.3m(388 ft)
Minimum Braking Ratio (BR)	0.31	0.31
Max Allowable Brake Actuation Forces	Hand lever force ≤245 N (55 lb) Foot pedal force ≤400 N (90 lb)	

48.3 km/h Data: Brake System 1

Brake pedal/lever force required to cause brake failureindicator to operate (N).									
Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1									
2									
3									
4									
5									
6									

5. Data Sheet No. 11 Partial Service Brake System–Split Service Brake System...Cont'd

96.6 km/h Data: Brake System 1

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1									
2									
3									
4									
5									
6									

48.3 km/h Data: Brake System 2

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1									
2									
3									
4									
5									
6									

96.6 km/h Data: Brake System 2

Brake pedal/lever force required to cause brake failureindicator to operate (N).									
Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1									
2									
3									
4									
5									
6									

5. Data Sheet No. 12 Parking Brake Test (S7.9)

Date:	Vehicle:	Test Rider/Technician:	Odometer Reading -	
			Start:	Finish:
N/A	N/A	N/A	N/A	N/A
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) -	
			Front	Rear
N/A	N/A	N/A	N/A	N/A

Test Conditions:

Initial Brake Temperature (IBT) between	54°C (130°F) and 66°C (150°F)	
Gradient	30%	
Stops Performed	Downhill direction - 1	Uphill direction - 1
Duration of each test	5 minutes	
Procedure	Drive the motorcycle downhill on the grade with the longitudinal axis of the motorcycle aligned with the direction of the slope of the grade. Apply the service brakes with a force not exceeding 400 N (90 lb) to stop the motorcycle and place the transmission in neutral. Apply the parking brake with a force not exceeding 400 N (90 lb) for a foot operated system, or 245 N (55 lb) for a hand operated system. Release the service brake and allow the motorcycle to remain at rest (to the limit of traction of the braked wheels) for test duration. Following observation of the vehicle in a stationary condition for the specified time in the downhill direction, repeat the same test procedure with the motorcycle oriented in the uphill direction on the same grade.	

Compliance requires the motorcycle to remain stationary (to the limits of traction) for 5 minutes in both the uphill and downhill directions.

Data:

Run No.	Pass?	Direction	Actuation Force (N)
1	N/A	Uphill	N/A
2	N/A	Downhill	N/A

5. Data Sheet No. 13 Wet Recovery Test – Service Brake System (S7.10)

Date:	Vehicle:	Test Rider:	Odometer Reading-miles	
			Start:	Finish:
4/3/03	C21201	T. Carter	196	198
Ambient Temperature	Wind Velocity/Direction:	Fuel Level:	Tire Pressure (cold) - kPa	
			Front	Rear
22.2°C	12 km/h from South	>3/4	200	225

This test consists of 2 sections: Baseline Check Stops (S7.10.1) and Wet Brake Recovery Stops (S7.10.2). The purpose of the Baseline Check Stops section is to determine the allowable brake actuation force limits for the fifth wet brake recovery stop. The Baseline Check Stops are performed first. Compliance requires that the fifth recovery stop brake actuation forces are within the computed limits.

Test Conditions – Baseline Check Stops:

Test speed	**48.3 km/h (30 mph)**
Initial Brake Temperature (IBT) between	**54°C (130°F) and 66°C (150°F)**
Number of Stops Performed	**3**
Deceleration Rate	**3.04 to 3.33 m/s^2 (10 to 11 ft/s^2) – The equivalent braking ratio is 0.31 to 0.34.**
Maximum Allowable Brake Actuation Forces	**Hand lever force ≤245 N (55 lb)**

48.3 km/h Baseline Check Data:

Run No.	Speed (km/h)	Dist (m)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	49.0	27.9	30	36	0.34	55	54		
2	48.5	27.4	32	36	0.34	57	57		
3	49.0	27.8	23	45	0.34	58	59		
Average Max Actuation Force (to be used in computing 5th recovery stop actuation force limits)			28.3	39.0					

5. Data Sheet No. 13 Wet Recovery Test – Service Brake System…Continued

Test Conditions – Recovery Stops:

Pre-Test Wetting Procedure	**Immerse rear brake in water fully released for 2 minutes followed by immersion of the front brake in water fully released for 2 minutes. The entire wetting procedure shall be completed in 7 minutes or less.**
Test	**Immediately after completion of wetting, accelerate at a maximum rate to the initial test speed without applying the brakes. Upon reaching the initial test speed, immediately conduct the wet brake recovery stops.**
Test speed	**48.3 km/h (30 mph)**
First Stop – Initial Brake Temperature (IBT) between	**Temperature achieved at completion of brake wetting**
IBT – Subsequent Stops	**IBT prior to brake applications for subsequent stops shall be those occurring at the end of each stop.**
Number of Stops Performed	**5 – Immediately after each stop accelerate as rapidly as possible to the test speed and make the next stop.**
Deceleration Rate	**3.04 to 3.33 m/s^2 (10 to 11 ft/s^2) – The equivalent braking ratio is 0.31 to 0.34.**
Stop Interval	**Distance sufficient to accelerate to initial test speed**
Maximum Allowable Brake Actuation Forces – Stops 1 through 4	**Hand lever force ≤245 N (55 lb)**
Maximum Allowable Brake Actuation Forces -- Stop 5	**See 5th Recovery Stop Actuation Force Limit Computation Table below.**

5th Recovery Stop Actuation Force Limit Computations (S5.4.3)			
Service Brake 1 (Front Brake)		Service Brake 2 (Rear Brake)	
Lower Limit Average Max Force (28.3 N) minus 44.5 N	Upper Limit – Average Max Force (28.3 N) plus 89 N	Lower Limit – Average Max Force (39.0 N) minus 44.5 N	Upper Limit Average Max Force (39.0 N) plus 89 N
0	**117.3**	**0**	**128.0**

48.3 km/h Recovery Stop Data (Selected compliance run is underlined):

Run No.	Speed (km/h)	Dist (in)	Max Front Force (N)	Max Rear Force (N)	BR	IBT °C			
						Frt	Rr		
1	48.5	29.8	43	46	0.31	20	21		
2	49.5	29.8	25	49	0.32	24	29		
3	49.2	28.9	25	46	0.33	28	40		
4	49.5	28.6	24	50	0.34	31	49		
5	48.5	29.6	22	41	0.31	34	55		

5. Data Sheet No. 14 Final Inspection (S7.11)

Date:	Vehicle:	Odometer Reading - miles
4/5/03	C21201	198

Inspection Requirements:

Disassemble all brakes and inspect for:	Pass?
Detachment or fracture of any component in the entire brake system.	**Yes**
Detachment of brake linings from any shoe or pad.	**Yes**
Fluid or lubricant leakage from wheel cylinder(s), master cylinder(s), axle seals, and any other component in the entire brake system.	**Yes**

APPENDIX 1 Instrumentation List

Listed below are the test instruments used for this program.

1. Motorcycle Third Wheel

   - Custom Built by Carter Engineering.
   - Tire Circumference: 4.462 feet ±0.227% (Original Calibration)
   - Tire circumference divided into 500 pulses with BEI Optical Encoder.
   - Calibration verified on 8/29/02

2. Brake Pedal and Lever Force Transducers

   - Strain gages - Micro-Measurements
   - Type CEA-13-062UW-350
   - Calibration on 3/7/03

3. Friction Material Thermocouples

   - Iron-Constantan Thermocouples, Type "K" - Omega
   - Plug Type as per drawings (Reference 1, 2 & 3)
   - Calibration on 2/15/03

4. Weather Station

   - Tullahoma Airport Weather Information Data

5. Continuous Data Recorders

   - Kaye Instruments, Inc.
   - DataFielder 200 Series
   - Model No. DF-200
   - Serial No.: 0569

   - Omnidata International, Inc.
   - Polycorder 700 Series
   - Model No. PC-704
   - Serial No.: 0180

6. Multiplexer

   - 80 Channel
   - Omnidata International, Inc.
   - Model No. PA-780-80
   - Serial No. PA7-131

7. Portable Computers

- Toshiba Model T3400CT
- Subnotebook Computer: 486-33 MHz, 8 megabyte RAM, 120 megabyte Hard Drive, Color Display.

- Dell Model Inspiron 3500
- Laptop Computer: Pentium II-300 MHz, 128 megabyte RAM, 6.4 gigabyte hard drive, Color Display.

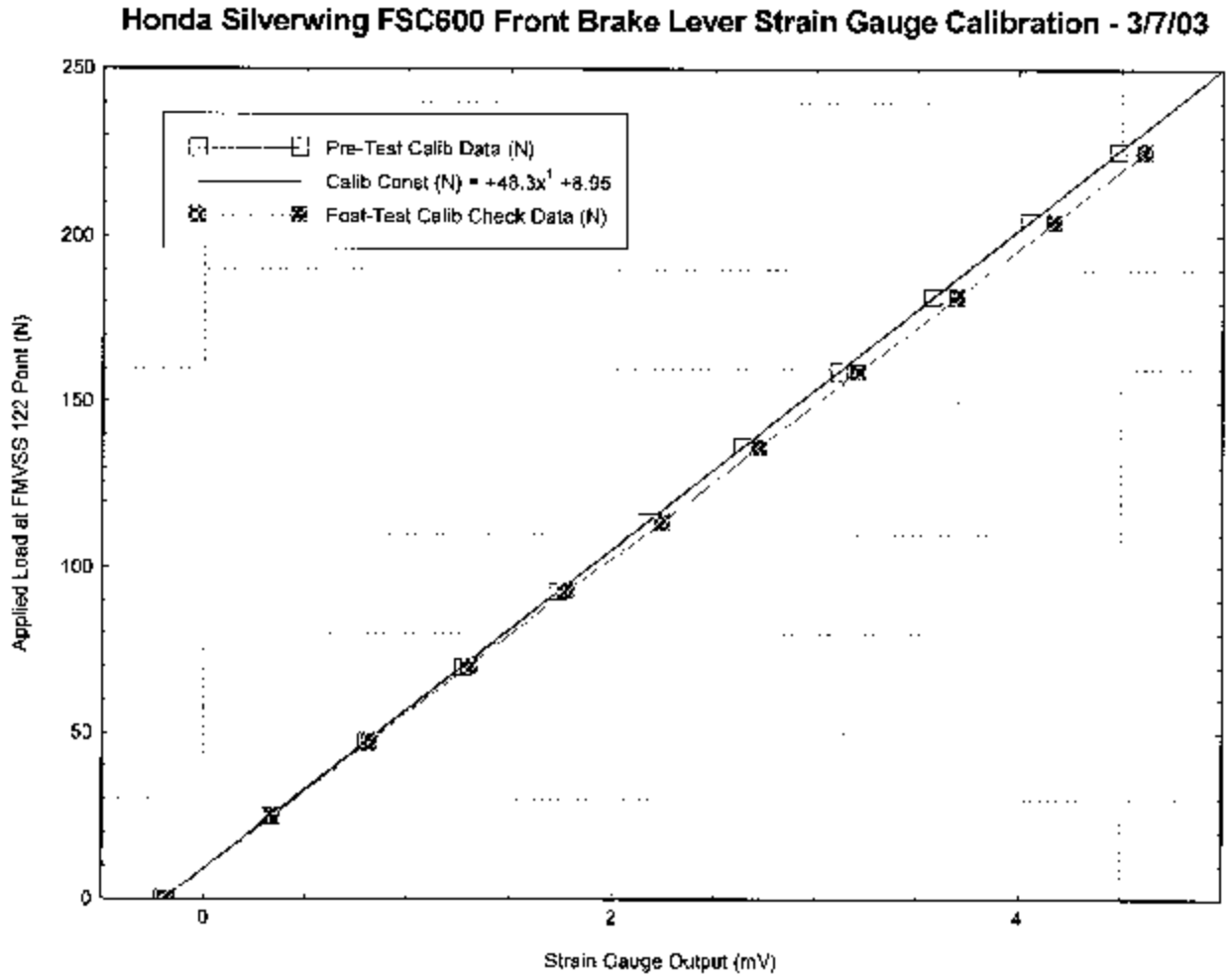
8. Certified Weights for Strain Gage Calibration

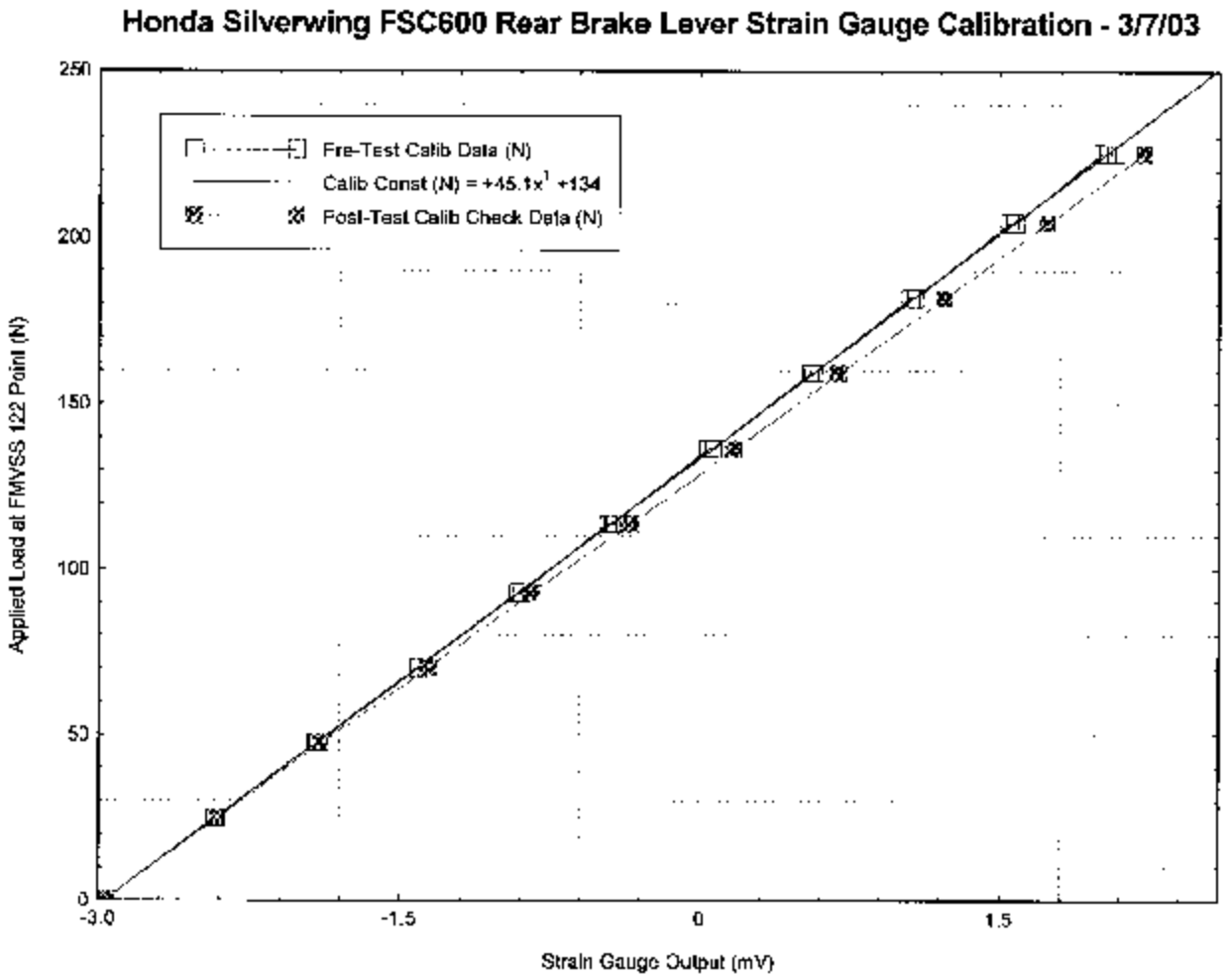
- Rite-Weights, Inc.
- NIST Traceable Certificate No. 6143
- Serial No. E854 & E855 - 2 lb.
- Serial No. E856 thru E859 - 5 lb.
- Serial No. E860 thru E862 - 25 lb.
- Serial No. E863 - 50 lb.

9. Portable Scales

- Intercomp Speed Weigh II Electronic Scales
- Serial No. SN8468
- Calibration on 4/7/02

APPENDIX 2 Hand Lever/Foot Pedal Actuation Force Calibration Curves




Honda Silverwing FSC600 Rear Brake Lever Strain Gauge Calibration - 3/7/03
Pre-Test Calib Data (N)
Calib Const (N) = +45.1x^1 +134
Post-Test Calib Check Data (N)
Applied Load at FMVSS 122 Point (N)
250
200
150
100
50
0
-3.0
-1.5
0
1.5
Strain Gauge Output (mV)

APPENDIX 3 Calculation of Master Cylinder Reservoir Volumes

Using the following equation for disk brakes:

$$V = N_c\left[N_p(\Delta t_i + C_i - \Delta t_o + C_o) \times \frac{\pi}{4} \times D^2\right] \qquad (1)$$

Where:

V = Volume required per braking system.
N_c = Number of calipers per braking system.
N_p = Number of pistons or piston pairs per caliper.
D = Caliper piston diameter.
C = Average clearance between brake pads and rotor.
t = Average change of brake pad & rotor thickness from new condition to fully worn.
i = Inboard.
o = Outboard.

The volume requirement for the <u>independent front brake</u> system of the test motorcycle was calculated as shown below:

Front Brake System - **N_c= 1**
N_p= 2
D = 2.7 cm
C = 0.0076 cm (typical)
t = 0.285 cm (Wear limit − 5 mm; Rotor wear limit = 1 mm (total). Average total thickness change per side = 5.5 mm → 0.55 cm)

$$V = 2\times\left[(2.7)^2 \times \frac{\pi}{4} \times (0.55 + 0.0076 + 0.55 + 0.0076)\right]$$

$$V = 12.8\,\text{cm}^3$$

Minimum volume required: $1.5 \times 12.8\,\text{cm}^3 - 19.2\,\text{cm}^3$

Measured volume of existing <u>front</u> brake system master cylinder reservoir ≅ 35+ cm^3.

Fluid volume measured with vehicle upright and level. Actual volume greater than reported above – reservoir installation precludes utilization of full volume.

The volume requirement for the combined rear brake system of the test motorcycle was calculated as shown below:

Front Brake System - **N_c= 2**
N_p= 3
D = 2.3 & 2.7 cm
C = 0.0076 cm (typical)
t = 0.565 cm (Wear limit = 3.8 mm (to bottom of slot); Rotor wear limit = 2 mm (total). Average total thickness change per side = 4.8 mm → 0.48 cm)

$$V = 2\times\left[(2.7)^2\times\frac{\pi}{4}\times(0.48+0.0076+0.48+0.0076)\right]+\left[(2.3)^2\times\frac{\pi}{4}\times(0.55+0.0076+0.55+0.0076)\right]$$

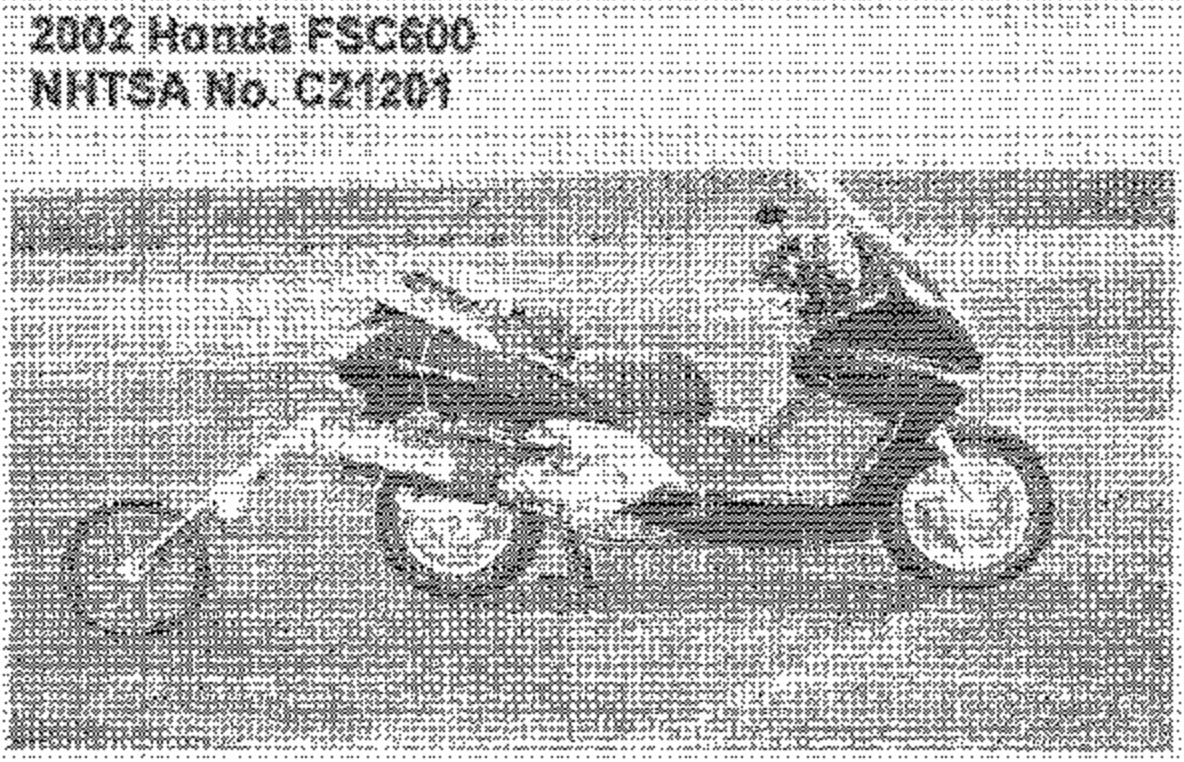
$$V = 15.8\,cm^3$$

Minimum volume required: $1.5\times15.8\,cm^3 = 23.7\,cm^3$

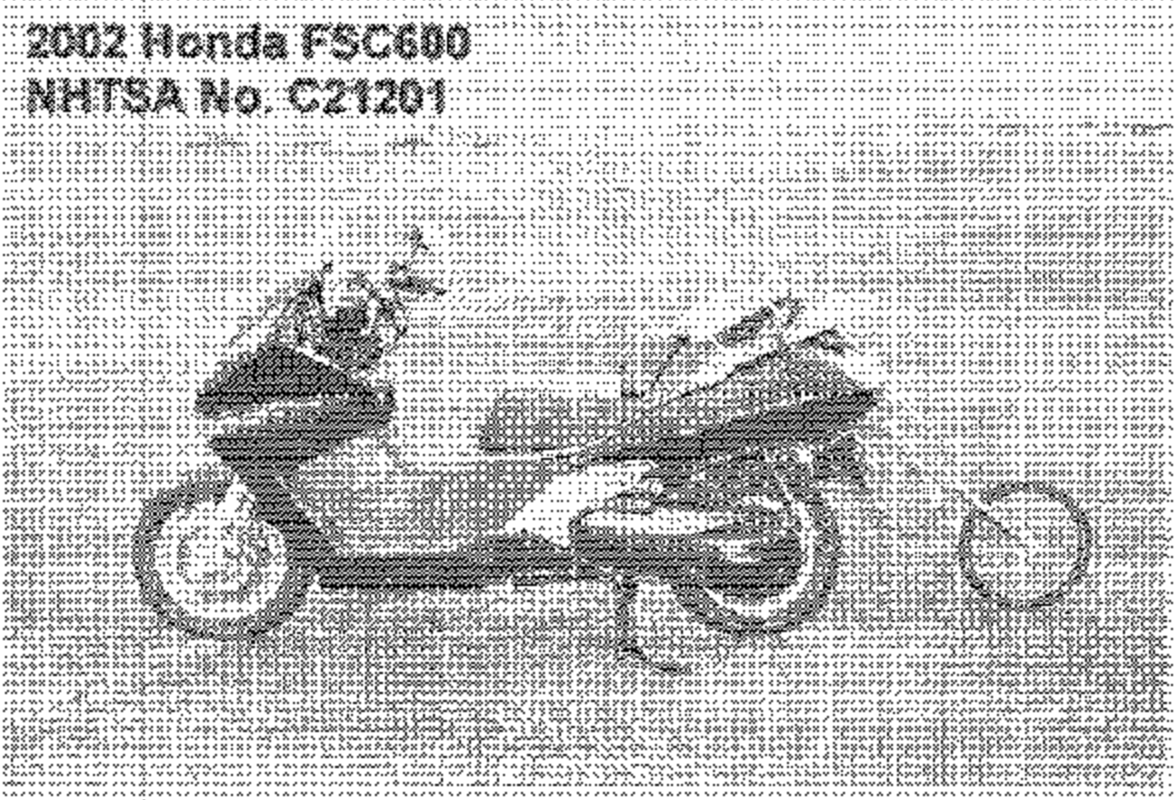
Measured volume of existing rear brake system master cylinder reservoir ≅ 35+ cm^3.

Fluid volume measured with vehicle upright and level. Actual volume greater than reported above – reservoir installation precludes utilization of full volume.

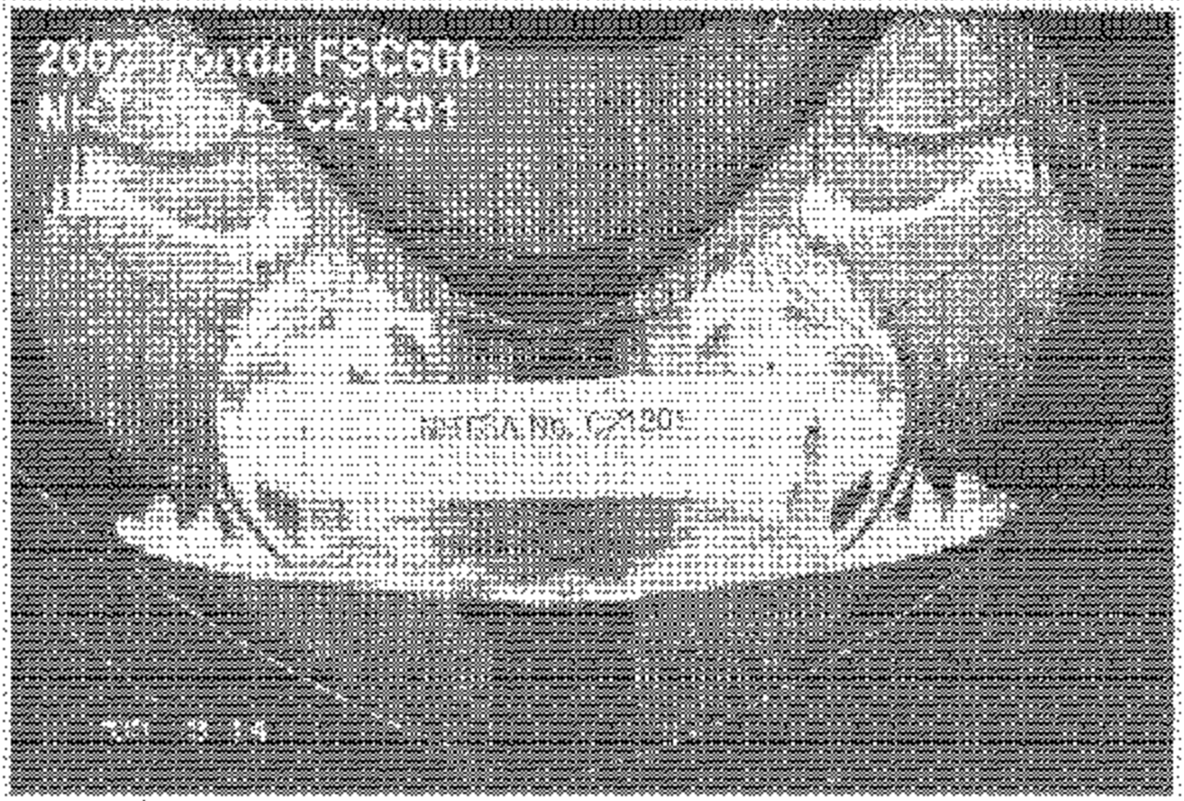
APPENDIX 4 **Photographs**



Photograph 1. Right Side View of the Test Motorcycle with Instrumentation Installed.

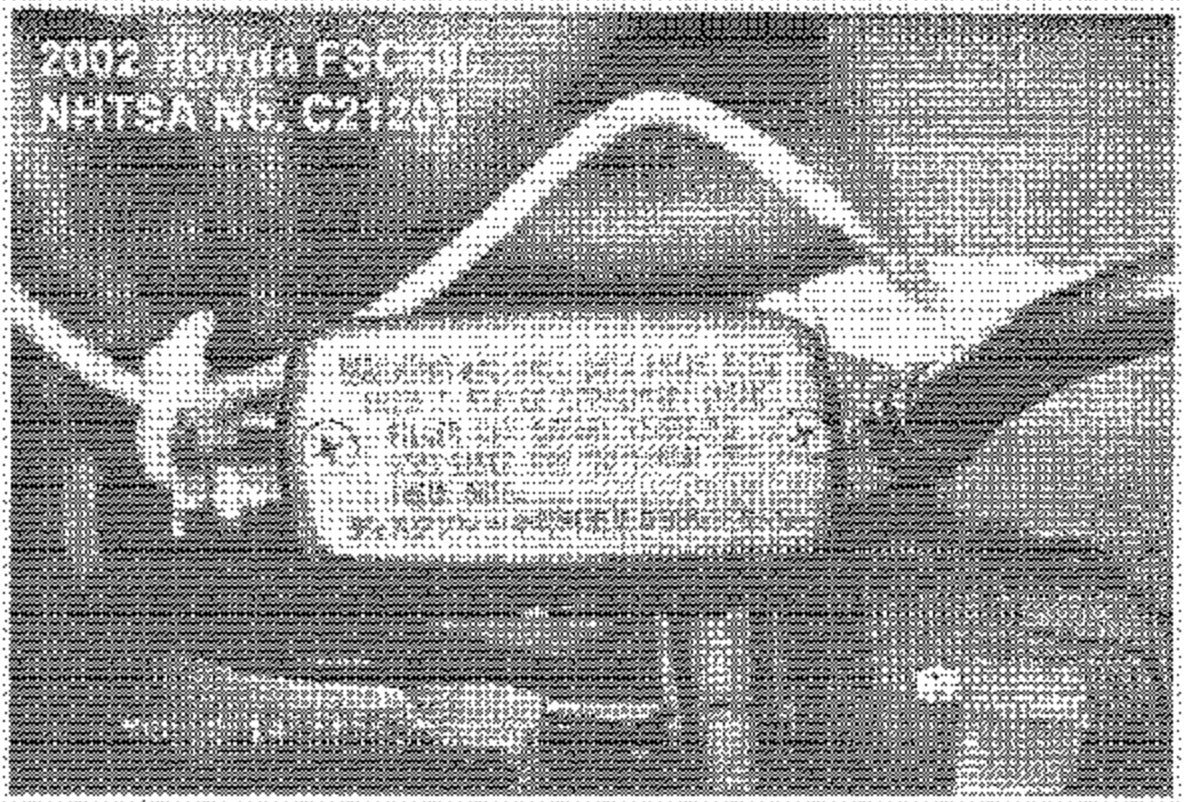


Photograph 2. Left Side View of the Test Motorcycle with Instrumentation Installed.

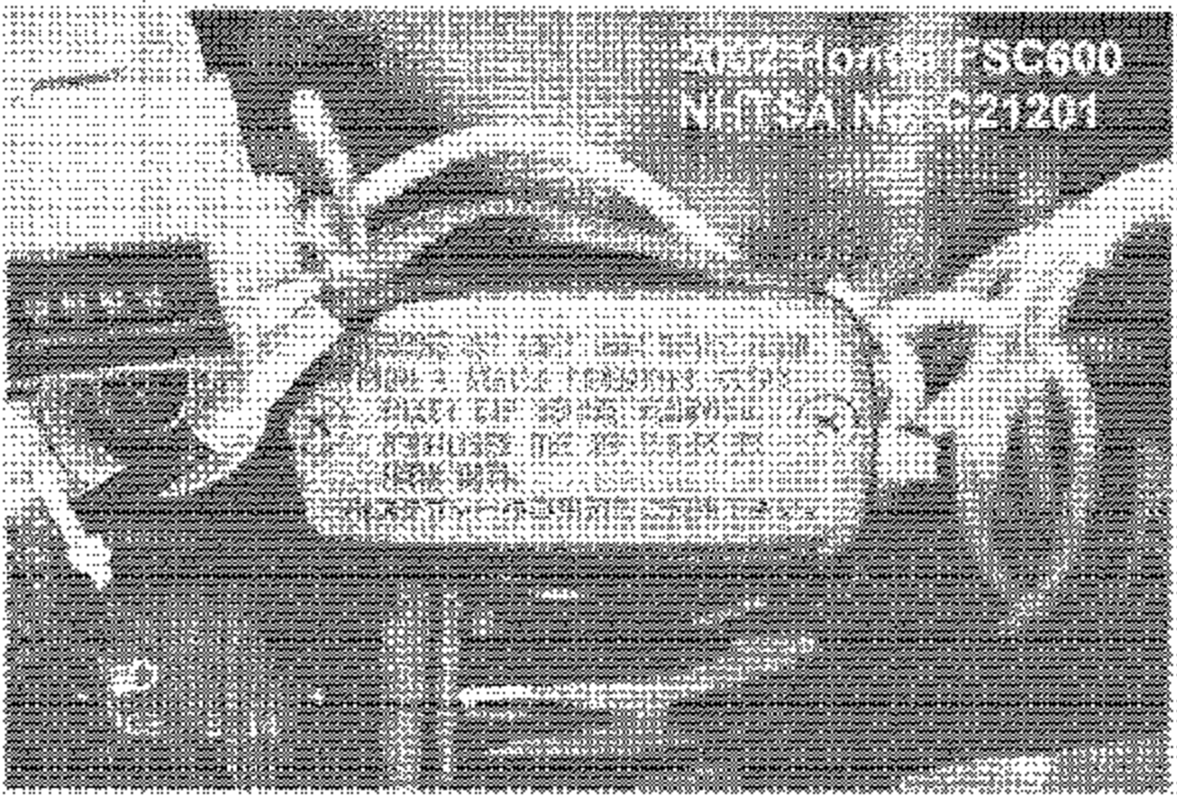


Photograph 3. Test Motorcycle NHTSA Number.

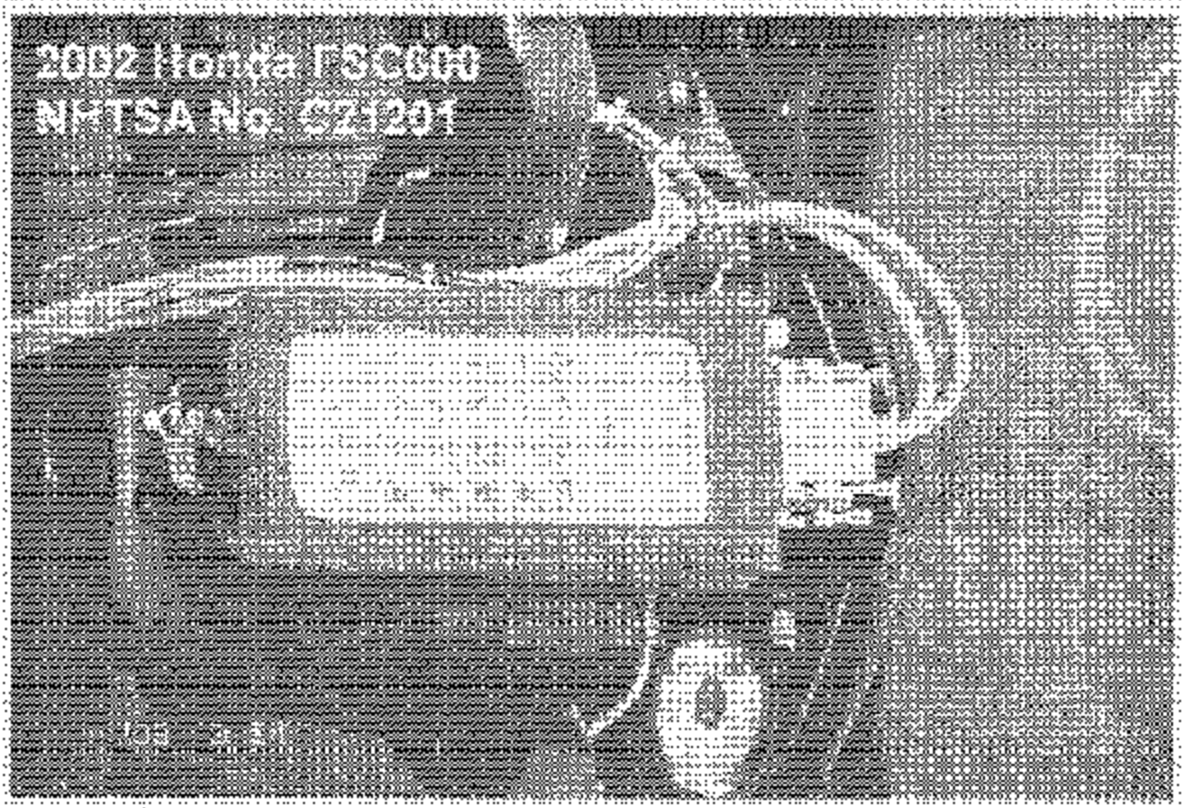
Photograph 4. Test Motorcycle Vehicle Certification Label.



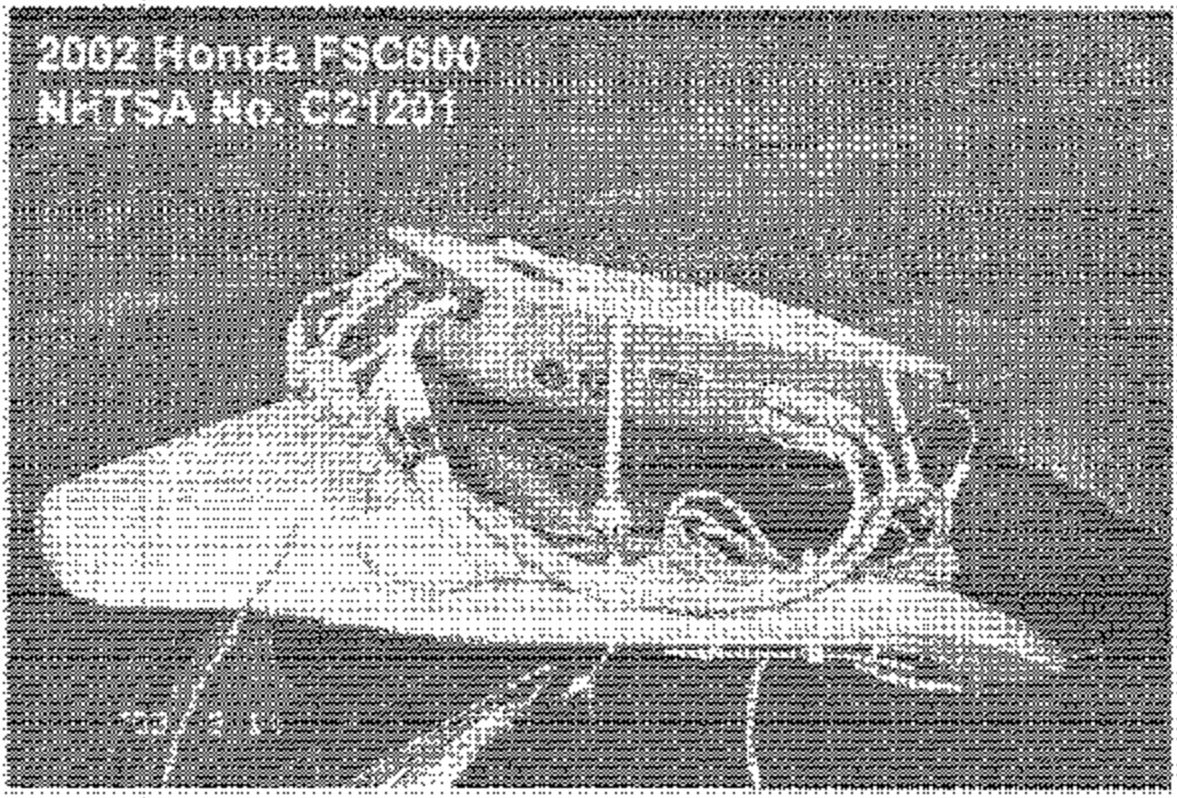
Photograph 5. Test Motorcycle Front Brake System Master Cylinder Reservoir Cover.



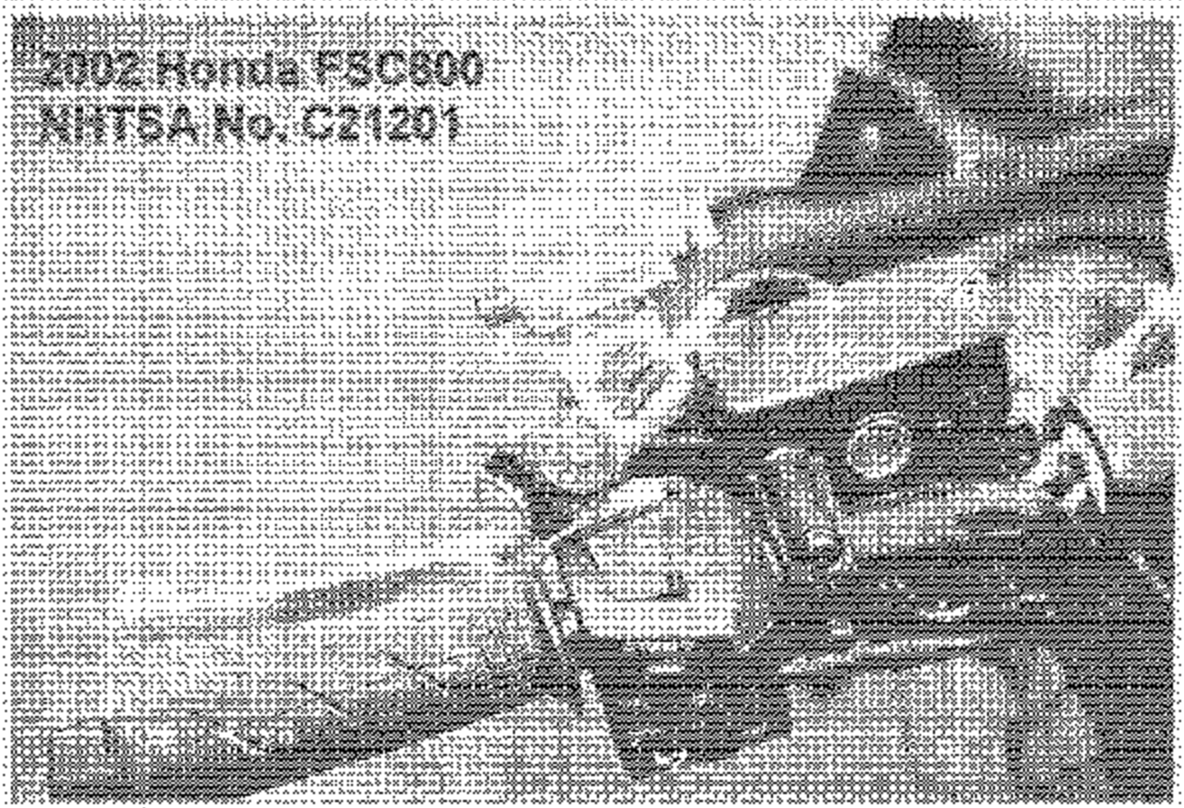
Photograph 6. Test Motorcycle Rear Brake System Master Cylinder Reservoir Cover.



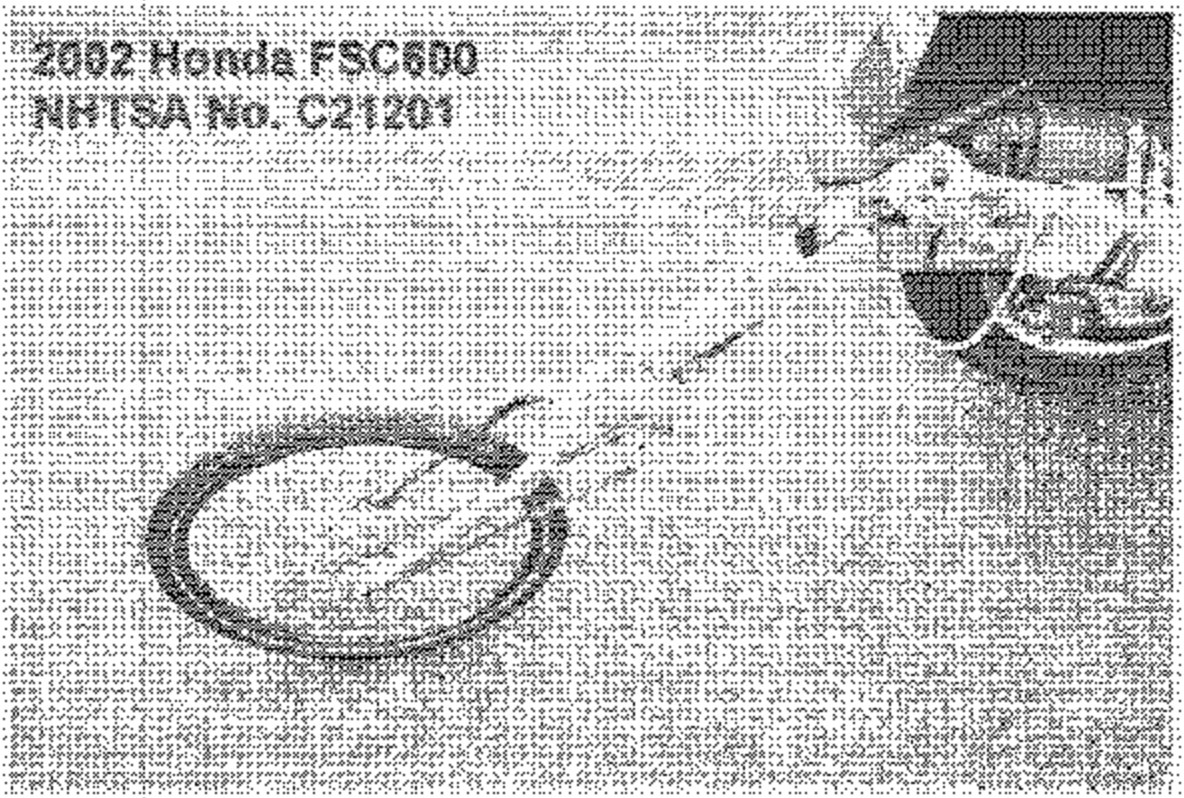
Photograph 7. Digital Data Recorder.



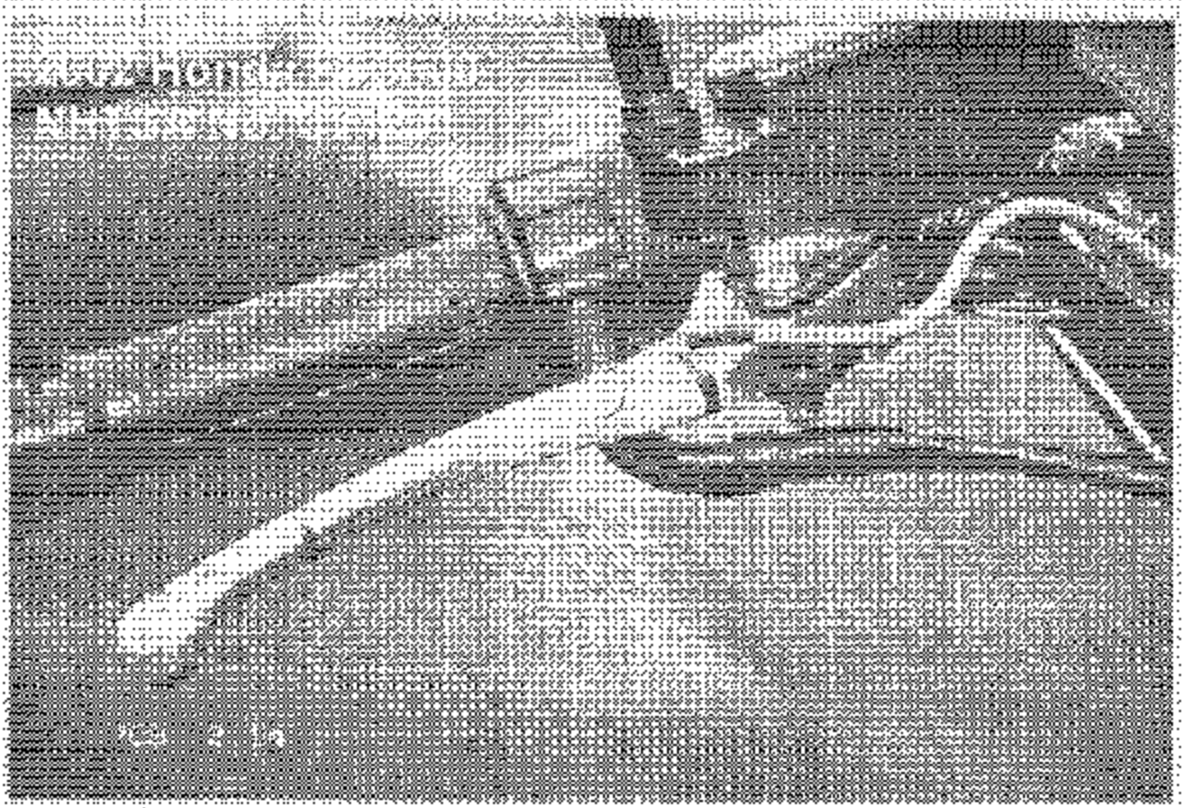
Photograph 8. Multiplexer - Attached to Rear of Motorcycle Seat.



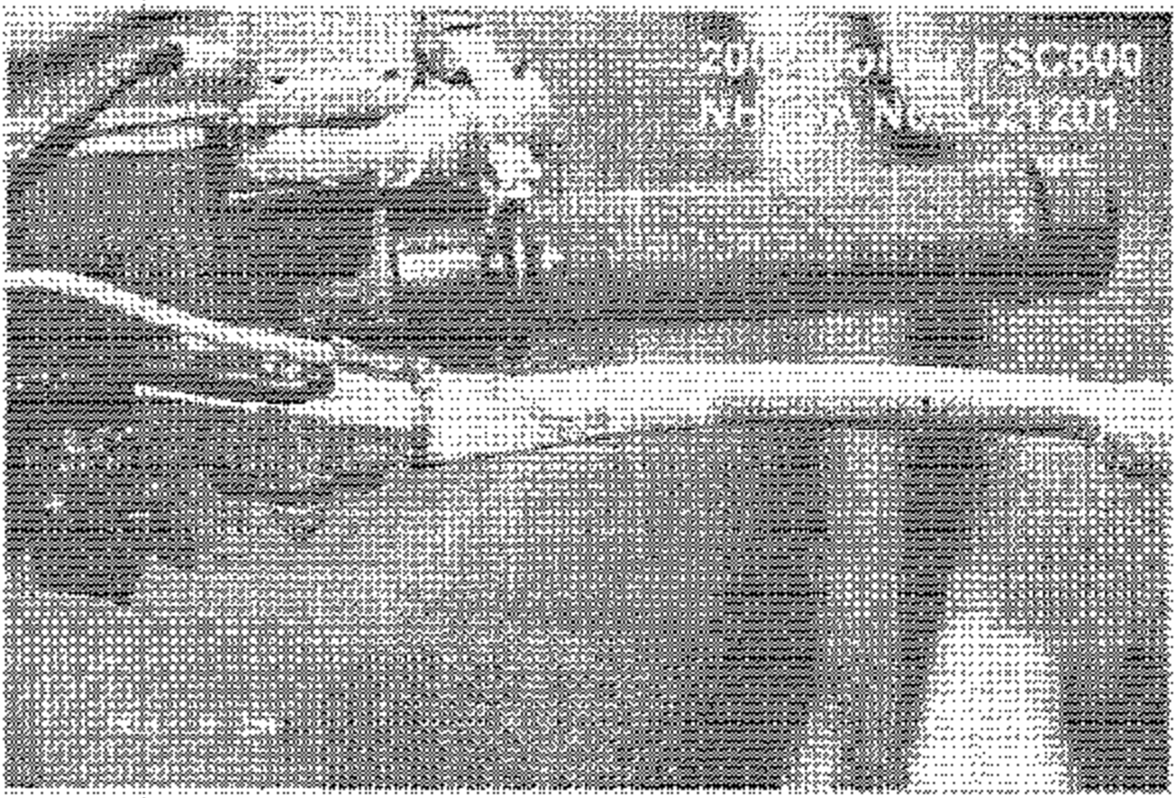
Photograph 9. Data Recorder Start Button and Mechanical Counter.



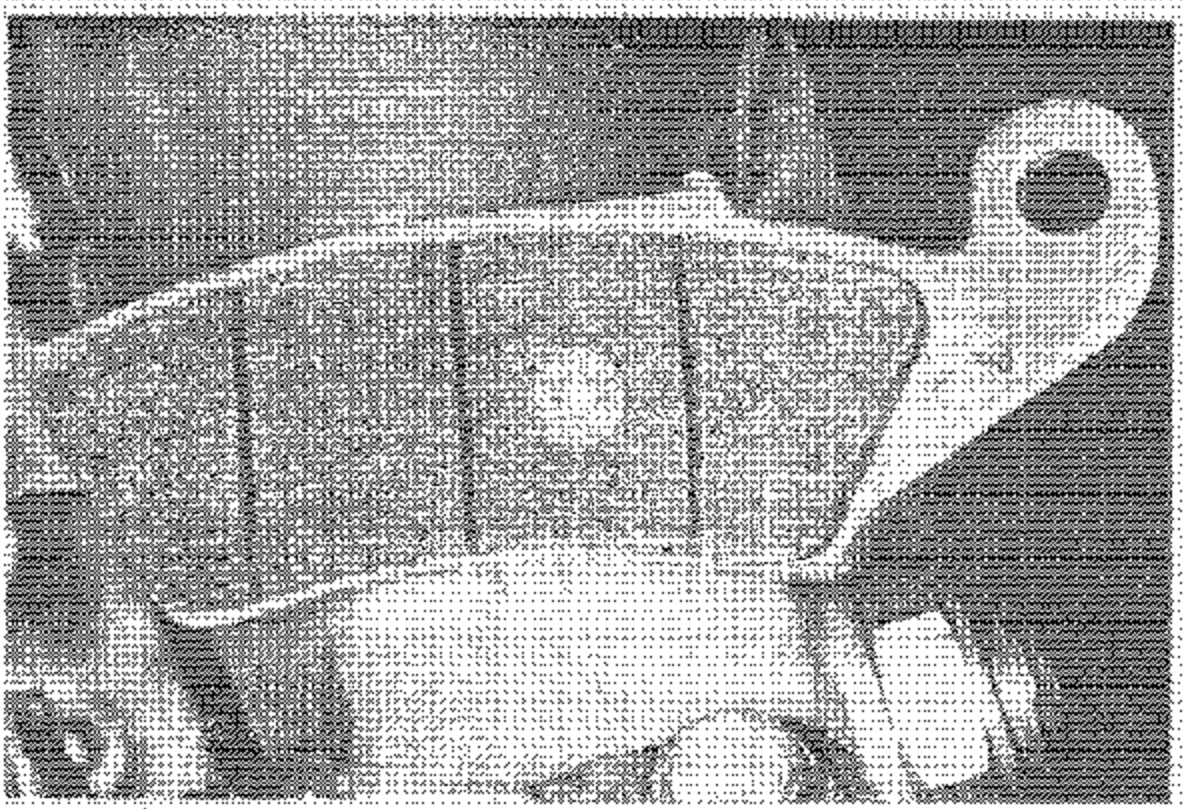
Photograph 10. Distance/Speed Sensor.



Photograph 11. Strain Gage Installation on Front Brake Lever.



Photograph 12. Strain Gage Installation on Rear Brake Lever.



Photograph 15. Typical Disk Brake Pad Thermocouple Installation.