

**INVESTIGATION OF FUEL TANK CRACKS  
1998-2005 SUZUKI VL1500 MOTORCYCLES**

**NHTSA Defect Investigation PE05-031  
Suzuki / NHTSA Meeting  
November 3, 2005**

## PREVIOUSLY REPORTED ACTIONS

- 1) **VEHICLE DEVELOPMENT DURABILITY TESTING**
  - 12 test programs / no problems
- 2) **EMISSIONS DURABILITY TESTING**
  - No problems
- 3) **COLLECTION OF REPLACED TANKS**
  - 5 tanks with hairline cracks collected
- 4) **INVESTIGATION OF TANK ASSEMBLY PROCESS**
  - No problems
- 5) **INVESTIGATION OF FUEL SEEPAGE**
  - No fuel drop

## ACTIONS COMPLETED SINCE PREVIOUS REPORT

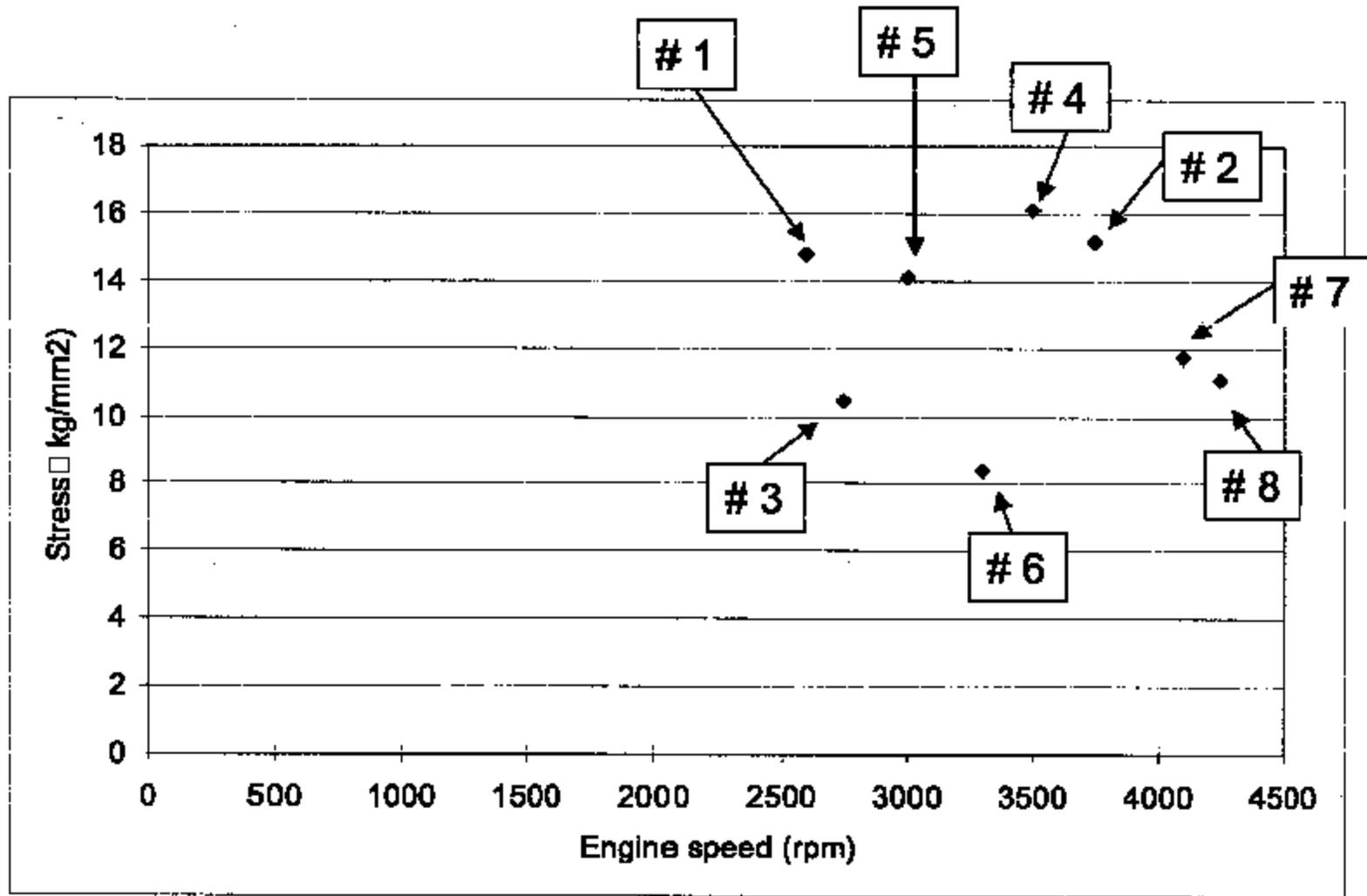
- 6) FUEL TANK STRESS INVESTIGATION
- 7) DURABILITY TESTING
- 8) ACCELERATED COMPONENT TESTING
- 9) INVESTIGATION OF MOTORCYCLE ASSEMBLY  
PROCESS
- 10) FUEL TANK COMPOSITION ANALYSIS

## FUEL TANK STRESS INVESTIGATION

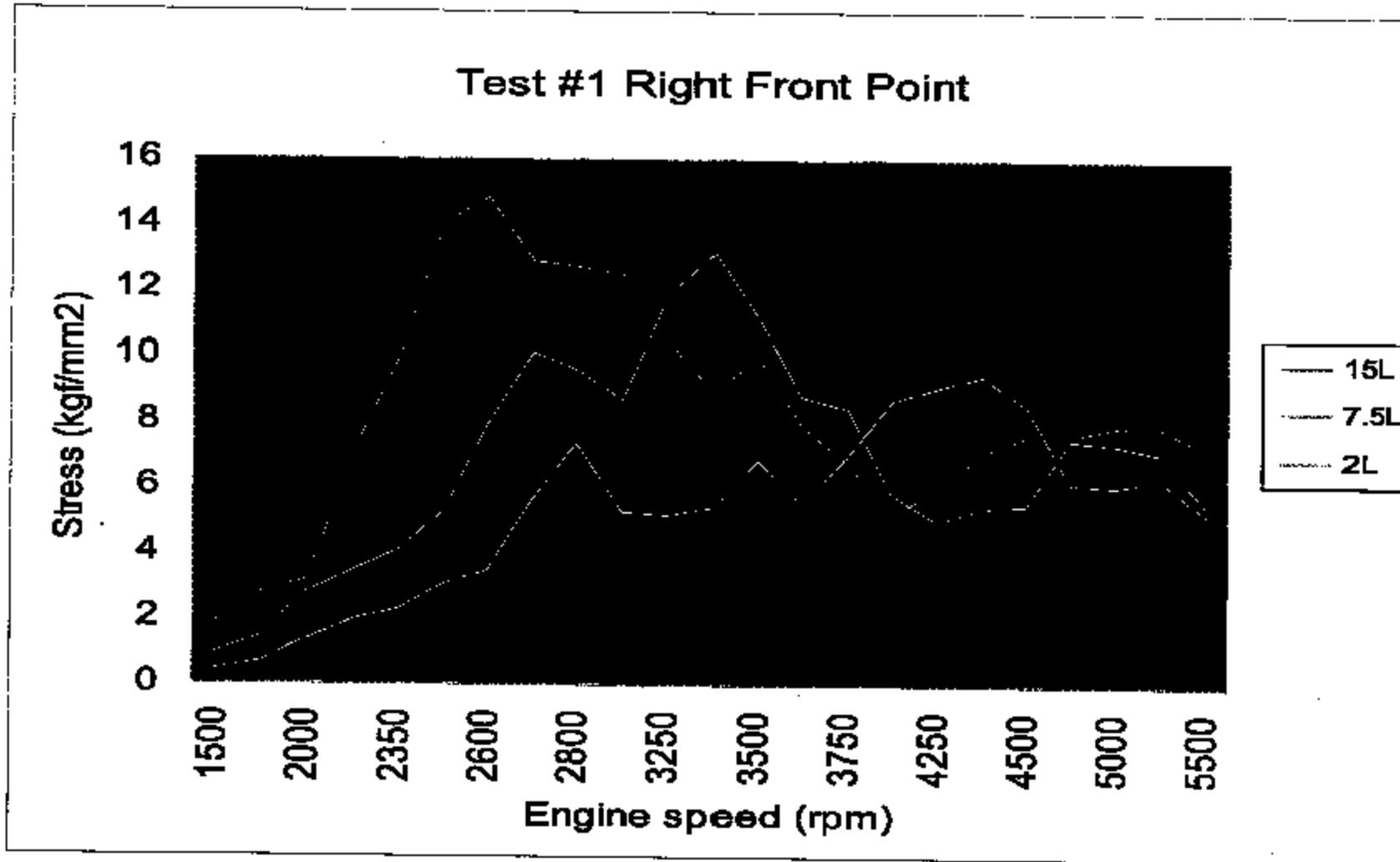
- HIGHEST STRESS MEASURED AT RIGHT FRONT MOUNTING LOCATION
- NO-LOAD ENGINE SPEED INCREASE
- 52 CONDITIONS EVALUATED

TEST NO.	TEST VEHICLE	FUEL TANK PART NO.	NO. OF FUEL LEVELS
1	VL1500TK5	44110-10FA0	3
2	VL1500K6	44110-10FA0	14
3			7
4			7
5	VL1500K5	44110-10F10	3
6			1
7	VL1500X		3
8			14

# FUEL TANK STRESS INVESTIGATION

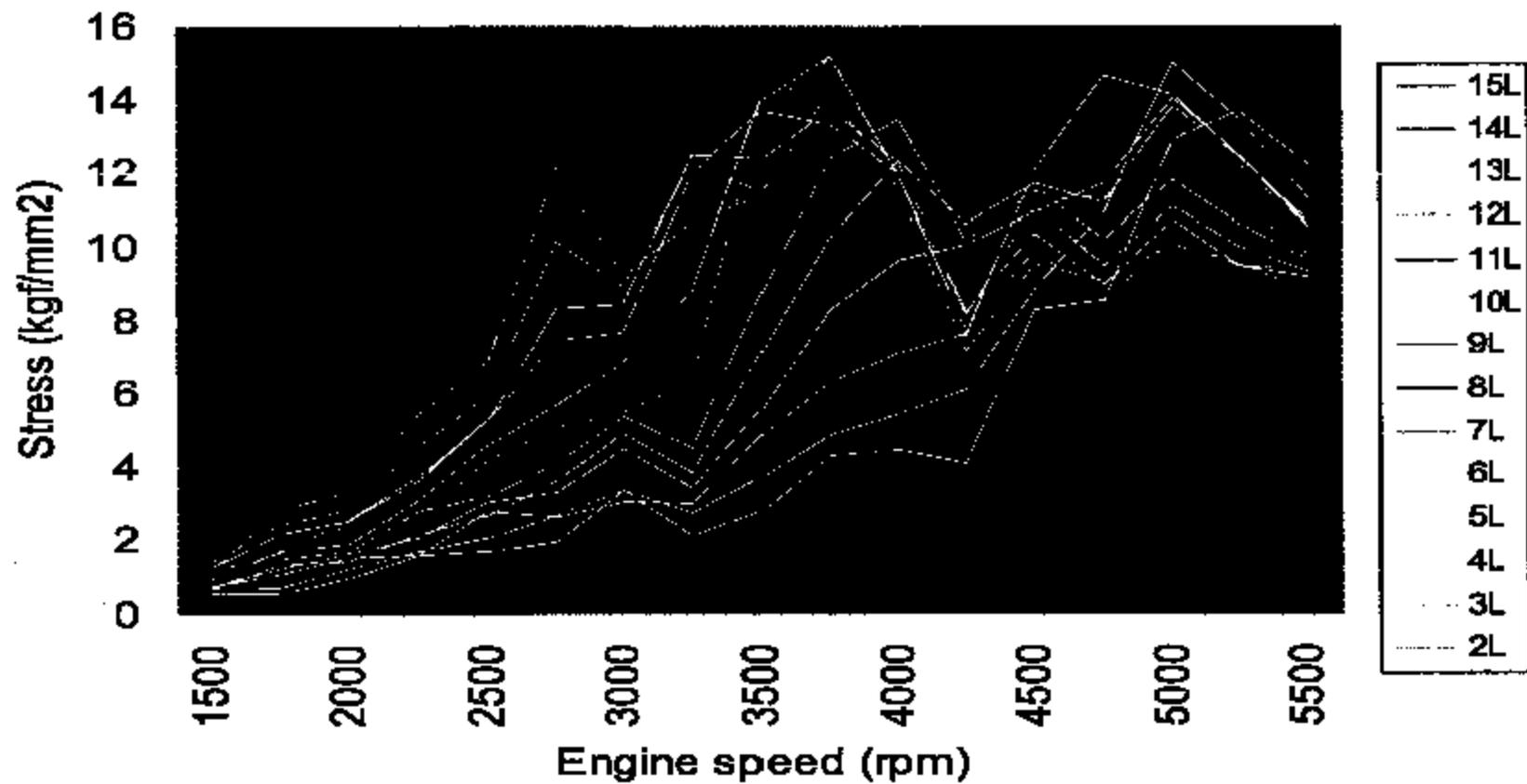


# FUEL TANK STRESS INVESTIGATION



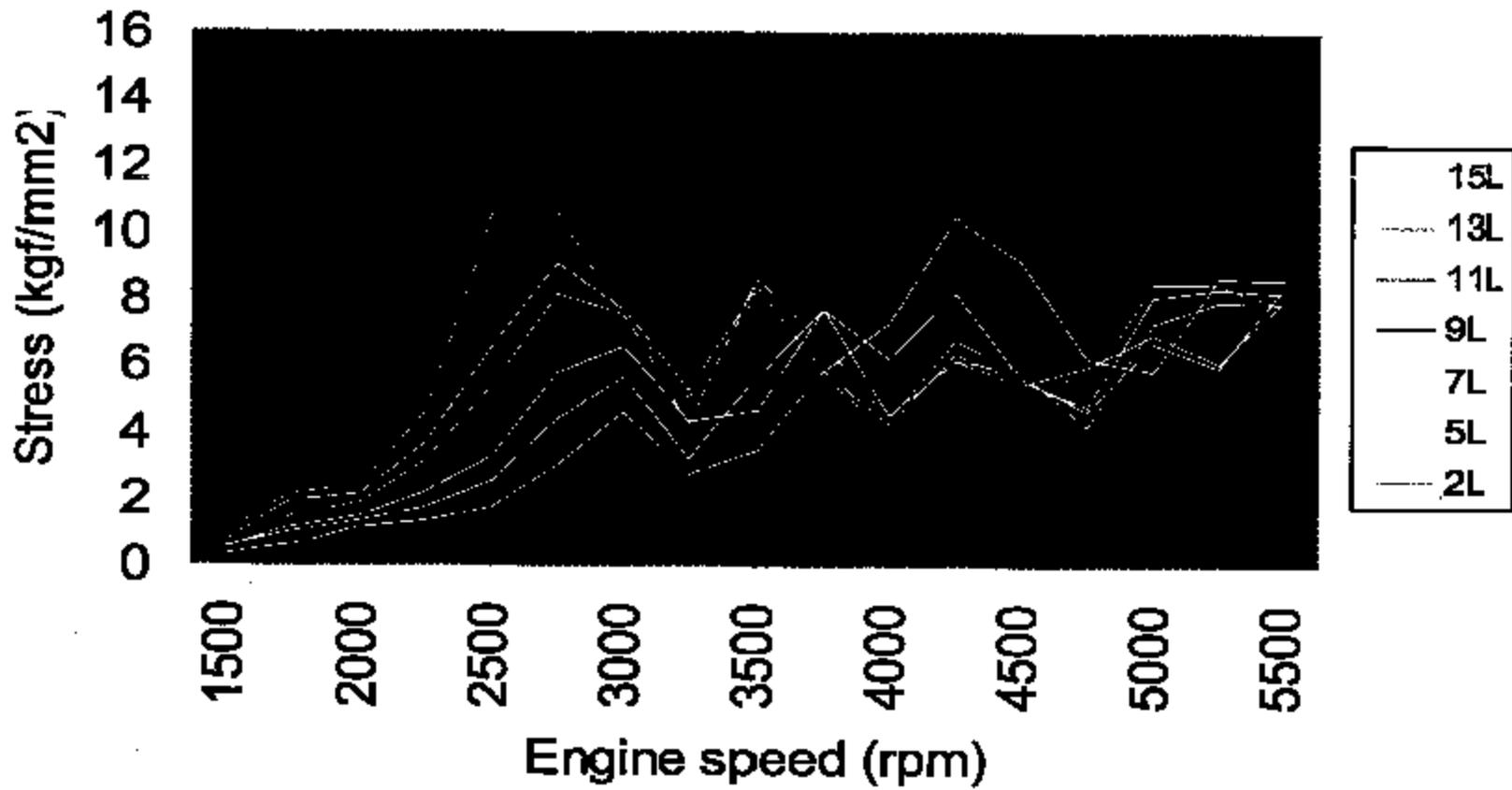
# FUEL TANK STRESS INVESTIGATION

Test #2 Right Front Point



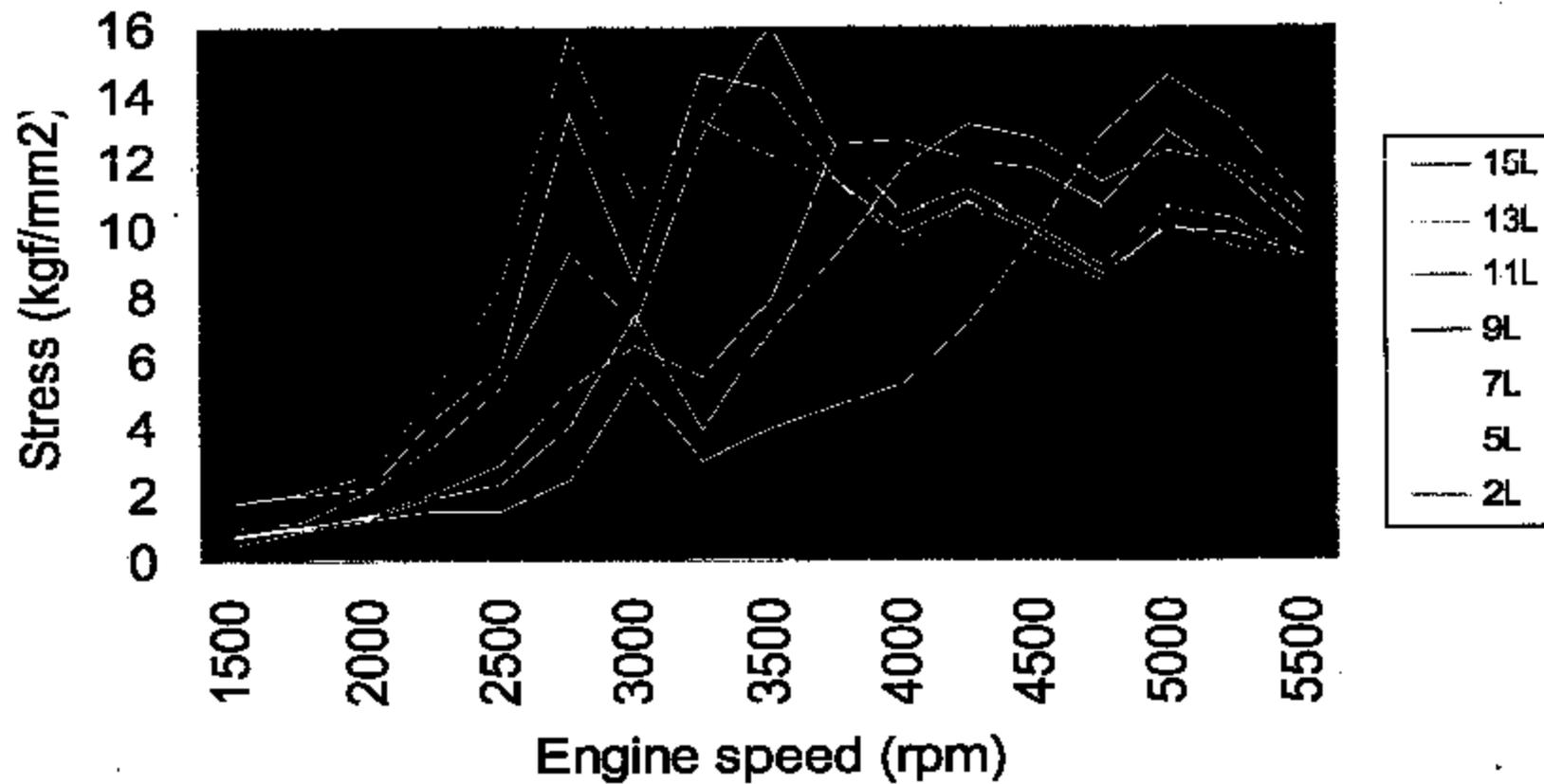
# FUEL TANK STRESS INVESTIGATION

Test #3 Right Front Point



# FUEL TANK STRESS INVESTIGATION

Test #4 Right Front Point



# FUEL TANK STRESS INVESTIGATION RESULTS

- **STRESS LEVEL DEPENDS ON ENGINE SPEED AND FUEL LEVEL**
  - Peak observed at 2750 rpm with full tank
  - Peak observed at 3500 rpm with 11 liters of fuel
- **MOST STRESS PEAKS ARE LESS THAN 15 kgf/mm<sup>2</sup>**
- **IN RARE CASES, STRESS LEVEL OF 16 kgf/mm<sup>2</sup> OBSERVED**
  - 2 out of 52 conditions

## DURABILITY TESTING

- REPEAT OF CHASSIS DYNAMOMETER TESTING DONE DURING DEVELOPMENT TEST PROGRAMS
- FUEL SEEPAGE FROM HAIRLINE CRACK DISCOVERED JUST BEFORE END OF TESTING
- TESTING STOPPED TO PURSUE ACCELERATED FUEL TANK COMPONENT TESTING TO GET QUICKER CONCLUSION.

## ACCELERATED COMPONENT TESTING

- STRAIN GAUGES AFFIXED AROUND RIGHT FRONT INSTALLATION POINT WHERE HIGHEST STRESS WAS MEASURED
- VIBRATOR USED TO PROVIDE STRESS INPUT
- 4 LEVELS OF STRESS EVALUATED
  - 10 kgf/mm<sup>2</sup>
  - 14 kgf/mm<sup>2</sup>
  - 15 kgf/mm<sup>2</sup>
  - 16 kgf/mm<sup>2</sup>

## ACCELERATED COMPONENT TESTING RESULTS

- NO CRACKS AFTER 10,000,000 REPETITIONS OF VIBRATION INPUT
  - 10 kgf/mm<sup>2</sup>
  - 14 kgf/mm<sup>2</sup>
  - 15 kgf/mm<sup>2</sup>
- FOR 16 kgf/mm<sup>2</sup>, HAIRLINE CRACK OBSERVED AFTER 1,000,000 REPETITIONS OF VIBRATION INPUT
  - Crack stopped expanding at 75 mm length after 20,000,000 repetitions
  - Testing stopped at 24,000,000 repetitions

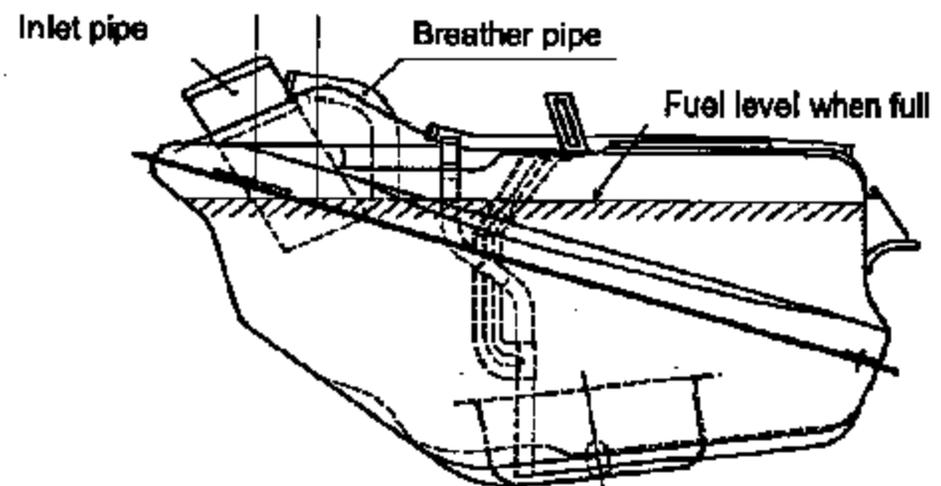
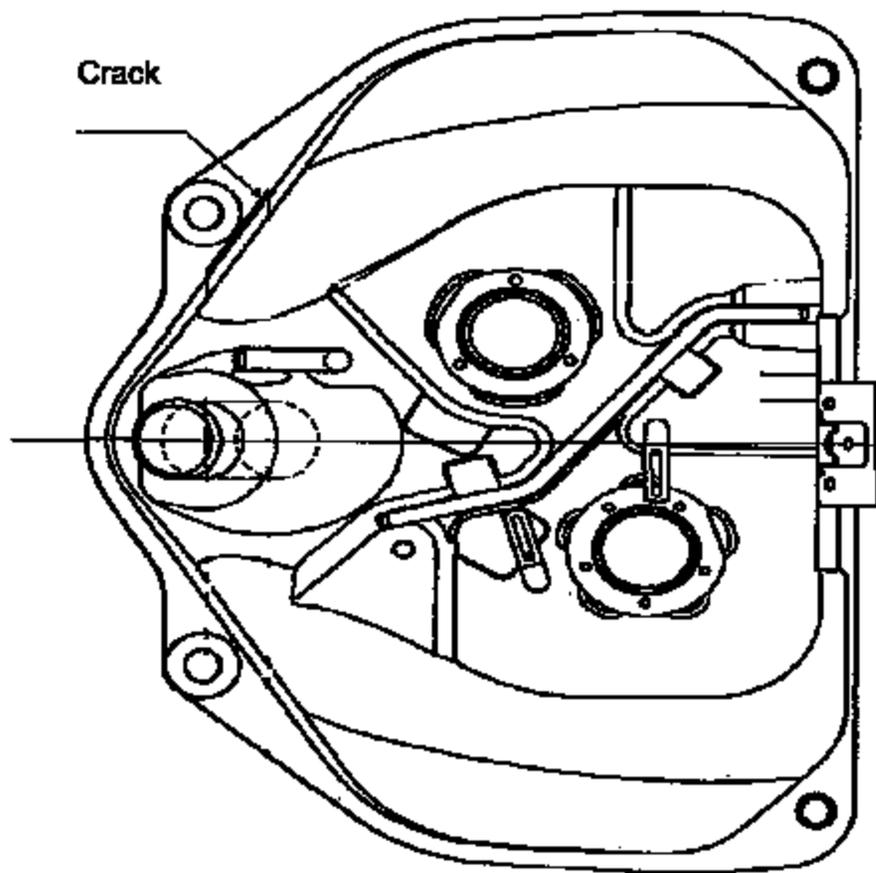
# INVESTIGATION OF MOTORCYCLE ASSEMBLY PROCESS

- **FUEL TANK INSTALLATION PROCESS**
  - No factors found
- **CHANGE HISTORY OF INSTALLATION PROCESS**
  - No process changes found

## FUEL TANK COMPOSITION ANALYSIS

- MICROSCOPIC ANALYSIS AND HARDNESS ANALYSIS CONDUCTED
- NO DEFECT IN FUEL TANK MATERIAL FOUND AT START POINT OF CRACK
- NO DIFFERENCE IN SEAM WELDING FOUND IN TANKS WITH AND WITHOUT CRACK

# FUEL TANK DESIGN



## CONCLUSIONS

- **FREQUENTLY REPEATED STRESS OF 16 kgf/mm<sup>2</sup> CAN CAUSE CRACK DUE TO METAL FATIGUE**
- **NO DEFECT TREND EXISTS**
  - ASMC has received 1 customer complaint, 18 field reports, and 29 warranty claims which may relate to alleged defect for population of 33,000 vehicles
  - SMC confirmed cracks in only 5 tanks for population of 60,000 vehicles
  - For very small number of vehicles, very unique conditions may produce stress of 16 kgf/mm<sup>2</sup> (stress peaks at 2750 rpm with full tank, 3500 rpm with 11 liters of fuel). Prolonged exposure to these unique conditions would be rare
  - 1,000,000 repetitions of 16 kgf/mm<sup>2</sup> stress needed for crack to start to form

## CONCLUSIONS

- **NO SIGNIFICANT RISK TO SAFETY EXISTS**
  - No reports of fire, accidents, or injuries
  - No liquid fuel drop was observed when testing with cracked tank
  - Crack is at right front installation point, so fuel drop when parked will not occur, even with full tank
  - Vibration testing shows that if crack occurs, it does not expand beyond 75 mm
  - If a crack occurs, the rider should notice the smell of gasoline from any fuel seepage and seek repair