REPORT NUMBER 124-GTL-07-001

SAFETY COMPLIANCE TESTING FOR FMVSS 124 ACCELERATOR CONTROL SYSTEMS

HYUNDAI MOTOR COMPANY
2007 HYUNDAI ELANTRA
4-DOOR PASSENGER CAR
NHTSA NO. C70502

GENERAL TESTING LABORATORIES, INC.
1623 LEEDSTOWN ROAD
COLONIAL BEACH, VIRGINIA 22443

OCTOBER 12, 2007

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 NEW JERSEY AVE, SE
WASHINGTON, D.C. 20590

Prepared By: Debbie Messick

Approved By: Grant Farrand

Approval Date: 10/12/07

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: Theresa M. Lawrence

Acceptance Date: 10/24/2007

Technical Report Documentation Page

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12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance (NVS-220) 1200 New Jersey Ave., S.E. Washington, DC 20590		13. Type of Report and Period Covered Final Test Report August 14-15, 2007 14. Sponsoring Agency Code NVS-220
15. Supplementary Notes		
16. Abstract Compliance tests were conducted on the subject 2007 Hyundai Elantra 4-Door Passenger Car in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-124-06 for the determination of FMVSS 124 compliance. Test failures identified were as follows: NONE		
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SECTION 1
PURPOSE OF COMPLIANCE TEST

FMVSS 124 specifies requirements for the return of a vehicle's throttle to the idle position when the driver removes the actuating force from the accelerator control, or in the event of a severance or disconnection in the accelerator control system. The purpose of FMVSS 124 is to reduce the number of deaths and injuries resulting from engine overspeed caused by malfunctions in the accelerator control system. This standard applies to passenger cars, multipurpose passenger vehicles (MPV's), trucks and buses.

SECTION 2
TEST PROCEDURES AND DISCUSSION OF RESULTS

Compliance testing was conducted on a 2007 Hyundai Elantra Passenger Car, NHTSA No. C70502 in accordance with the National Highway Traffic Safety Administration (NHTSA) Laboratory Procedure TP-124-06.

Output from the vehicle throttle position sensor on the air throttle plate shaft was used to measure throttle position and data was recorded at 100 HZ with GTL' s data acquisition system. Testing was conducted to simulate the normal removal of the driver's foot from the accelerator pedal. This was performed by depressing the accelerator with a gloved hand which incorporated an electrical contact strip in the depressing forefinger. The accelerator was depressed to the required amount and then the forefinger was quickly removed from the pedal, releasing the accelerator and activating the contact strip for time zero. Testing was performed with the vehicle in park and the engine running. Return to idle times were determined for four throttle plate positions with the accelerator control system complete and with each of the two throttle return springs on the throttle plate shaft independently disconnected and the accelerator return spring on the accelerator pedal disconnected. The severed linkage test was also performed by disconnecting the throttle cable from the throttle body and replacing the cable with another cable which could be quickly severed to simulate a broken throttle cable. The cable was then activated to the required amount of throttle opening and the cable was severed to simulate cable failure. As the air throttle plate was mechanically linked to the accelerator pedal, no electrical disconnections were required.

This testing was performed at mid ambient temperature of 10º C to 46º C, in accordance with the NHTSA Test Procedure TP-124-06.

SECTION 3
COMPLIANCE TEST DATA

Test data for this test can be found on the following pages. Photographs are found in Section 5 and Test Plots are found in Section 6.

DATA SHEET 1
VEHICLE DESCRIPTION

VEHICLE MY/MAKE/MODEL/BODY STYLE: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEHICLE NHTSA NO.: C70502
VEHICLE VIN: KMHDU46D97U035111
DATE OF TEST: APRIL 14-15, 2007
TEST LAB: GENERAL TESTING LABORATORIES
VEHICLE ENGINE TYPE: GAS GVWR: 1755 KG
VEHICLE ENGINE SIZE: 2.5 L 4CYL.
VEHICLE ACCEL. CONTROL SYSTEM (ACS) (Air or Fuel Throttled): AIR
MAX. BHP ENGINE SPEED: UNKNOWN
MFR. IDLE RPM: 660 RPM ±100
FUEL METERING DEVICE (Carburetor, fuel injection, etc): FUEL INJECTION

REMARKS: None

RECORDED BY: G. FARRAND DATE: 08/14/07

APPROVED BY: D. MESSICK

DATA SHEET 2
NORMAL OPERATION TEST
(fully operational system)

VEHICLE MY/MAKE/MODEL/BODY STYLE: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEHICLE NHTSA NO.: C70502
DATE OF TEST: AUGUST 15, 2007

Check one:

Mid Temp. Test: X Low Temp. Test: High Temp. Test:

SYSTEM CONDITION: COMPLETE (no modifications) Normal Operation

GTL #	ACCELERATOR POSITION % WIDE OPEN THROTTLE (WOT)	THROTTLE POSITION SENSOR READING	RPM	TEMPERATURE (ºC)		THROTTLE POSITION SENSOR READING @ IDLE (BASELINE)	RETURN TIME TO IDLE (Msec)	PASS/ FAIL
				ENGINE COOLANT	AMBIENT			
5741	25%	21%	660	82	28	1%	20	P
5742	50%	48%	660	82	28	1%	30	P
5743	75%	76%	660	82	29	1%	30	P
5744	100%	100%	660	82	30	1%	40	P

RETURN TIME REQUIREMENTS:

1 second (1000 ms) for vehicles less than 4536 kg.
2 seconds (2000 ms) for vehicles more than 4536 kg.
3 seconds (3000 ms) for vehicles exposed to -18º C or less

PASS X FAIL

REMARKS: None

RECORDED BY: G. FARRAND DATE: 08/15/07

APPROVED BY: D. MESSICK

DATA SHEET 3 (1 of 3)
FAIL-SAFE OPERATION DISCONNECTION

VEHICLE MY/MAKE/MODEL/BODY STYLE: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEHICLE NHTSA NO.: C70502
DATE OF TEST: AUGUST 15, 2007

Check one:

Mid Temp. Test: X Low Temp. Test: High Temp. Test:

SYSTEM CONDITION: #1 SPRING DISCONNECTED

GTL #	ACCELERATOR POSITION % WIDE OPEN THROTTLE (WOT)	THROTTLE POSITION SENSOR READING	RPM	TEMPERATURE (ºC)		THROTTLE POSITION SENSOR READING @ IDLE (BASELINE)	RETURN TIME TO IDLE (Msec)	PASS/ FAIL
				ENGINE COOLANT	AMBIENT			
5745	25%	21%	660	82	32	1%	20	P
5746	50%	53%	660	82	32	1%	40	P
5747	75%	73%	660	82	32	1%	40	P
5748	100%	100%	660	82	32	1%	20	P

RETURN TIME REQUIREMENTS:

1 second (1000 ms) for vehicles less than 4536 kg.
2 seconds (2000 ms) for vehicles more than 4536 kg.
3 seconds (3000 ms) for vehicles exposed to -18º C or less

PASS X FAIL

REMARKS: None

RECORDED BY: G. FARRAND DATE: 08/15/07

APPROVED BY: D. MESSICK

DATA SHEET 3 (2 of 3)
FAIL-SAFE OPERATION DISCONNECTION

VEHICLE MY/MAKE/MODEL/BODY STYLE: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEHICLE NHTSA NO.: C70502
DATE OF TEST: AUGUST 15, 2007

Check one:

Mid Temp. Test: X Low Temp. Test: High Temp. Test:

	SYSTEM CONDITION: #2 SPRING DISCONNECTED							
GTL #	ACCELERATOR POSITION % WIDE OPEN THROTTLE (WOT)	THROTTLE POSITION SENSOR READING	RPM	TEMPERATURE (ºC)		THROTTLE POSITION SENSOR READING @ IDLE (BASELINE)	RETURN TIME TO IDLE (Msec)	PASS/ FAIL
				ENGINE COOLANT	AMBIENT			
5749	25%	29%	660	82	32	1%	30	P
5750	50%	52%	660	82	32	1%	30	P
5751	75%	73%	660	82	32	1%	40	P
5752	100%	100%	660	82	32	1%	50	P

RETURN TIME REQUIREMENTS:

1 second (1000 ms) for vehicles less than 4536 kg.
2 seconds (2000 ms) for vehicles more than 4536 kg.
3 seconds (3000 ms) for vehicles exposed to -18º C or less

PASS X FAIL

REMARKS: None

RECORDED BY: G. FARRAND DATE: 08/15/07

APPROVED BY: D. MESSICK

DATA SHEET 3 (3 of 3)
FAIL-SAFE OPERATION DISCONNECTION

VEHICLE MY/MAKE/MODEL/BODY STYLE: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEHICLE NHTSA NO.: C70502
DATE OF TEST: AUGUST 15, 2007

Check one:

Mid Temp. Test: X Low Temp. Test: High Temp. Test:

	SYSTEM CONDITION: #3 SPRING DISCONNECTED							
GTL #	ACCELERATOR POSITION % WIDE OPEN THROTTLE (WOT)	THROTTLE POSITION SENSOR READING	RPM	TEMPERATURE (ºC)		THROTTLE POSITION SENSOR READING @ IDLE (BASELINE)	RETURN TIME TO IDLE (Msec)	PASS/ FAIL
				ENGINE COOLANT	AMBIENT			
5753	25%	26%	660	84	32	1%	40	P
5754	50%	48%	660	84	32	1%	40	P
5755	75%	70%	660	84	32	1%	100	P
5756	100%	100%	660	84	32	1%	60	P

RETURN TIME REQUIREMENTS:

1 second (1000 ms) for vehicles less than 4536 kg.
2 seconds (2000 ms) for vehicles more than 4536 kg.
3 seconds (3000 ms) for vehicles exposed to -18º C or less

PASS X FAIL

REMARKS: None

RECORDED BY: G. FARRAND DATE: 08/15/07

APPROVED BY: D. MESSICK

DATA SHEET 4
FAIL-SAFE OPERATION SEVERED

VEHICLE MY/MAKE/MODEL/BODY STYLE: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEHICLE NHTSA NO.: C70502
DATE OF TEST: AUGUST 15, 2007

Check one:

Mid Temp. Test: X Low Temp. Test: High Temp. Test:

SYSTEM CONDITION: SEVERANCE OF THROTTLE CABLE

GTL #	ACCELERATOR POSITION % WIDE OPEN THROTTLE (WOT)	THROTTLE POSITION SENSOR READING	RPM	TEMPERATURE (ºC)		THROTTLE POSITION SENSOR READING @ IDLE (BASELINE)	RETURN TIME TO IDLE (Msec)	PASS/ FAIL
				ENGINE COOLANT	AMBIENT			
5757	25%	25%	660	84	32	1%	20	P
5758	50%	50%	660	84	32	1%	30	P
5759	75%	75%	660	84	32	1%	20	P
5760	100%	100%	660	84	32	1%	40	P

RETURN TIME REQUIREMENTS:

1 second (1000 ms) for vehicles less than 4536 kg.
2 seconds (2000 ms) for vehicles more than 4536 kg.
3 seconds (3000 ms) for vehicles exposed to -18º C or less

PASS X FAIL

REMARKS: None

RECORDED BY: G. FARRAND DATE: 08/15/07

APPROVED BY: D. MESSICK

SECTION 4
TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO.	CAL. DATE	NEXT CAL. DATE
CONTINUOUS RECORDER	OMEGA	CT485	06/07	06/08
ENGINE RECORDING	GTL COMPUTER	CPU1	BEFORE USE	BEFORE USE
ENGINE RECORDING	MONARCH	1444664	08/07	08/08
SOFTWARE	GTL	N/A	BEFORE USE	BEFORE USE
CHAMBER	GTL	N/A	N/A	N/A
EXHAUST DUCT	GTL	N/A	N/A	N/A

SECTION 5
PHOTOGRAPHS

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.1
FRONT VIEW OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.2
LEFT SIDE VIEW OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.3
RIGHT SIDE VIEW OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.4
CLOSE-UP VIEW OF VEHICLE CERTIFICATION LABEL

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

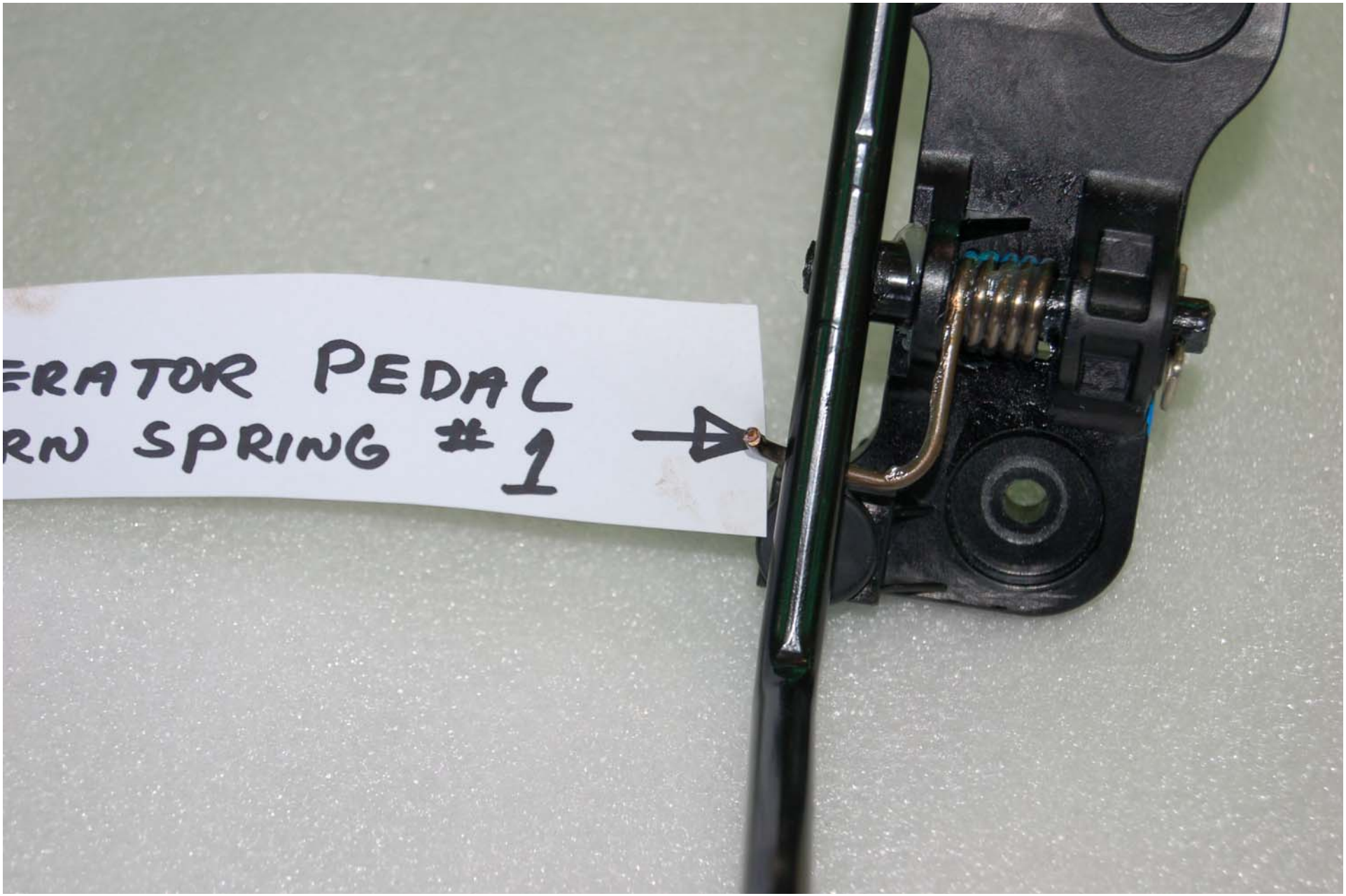
FIGURE 5.5
CLOSE-UP VIEW OF VEHICLE PLACARD

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.6
ACCELERATOR PEDAL ASSEMBLY

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.7
ACCELERATOR PEDAL ASSEMBLY SHOWING
SPRING #1



2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

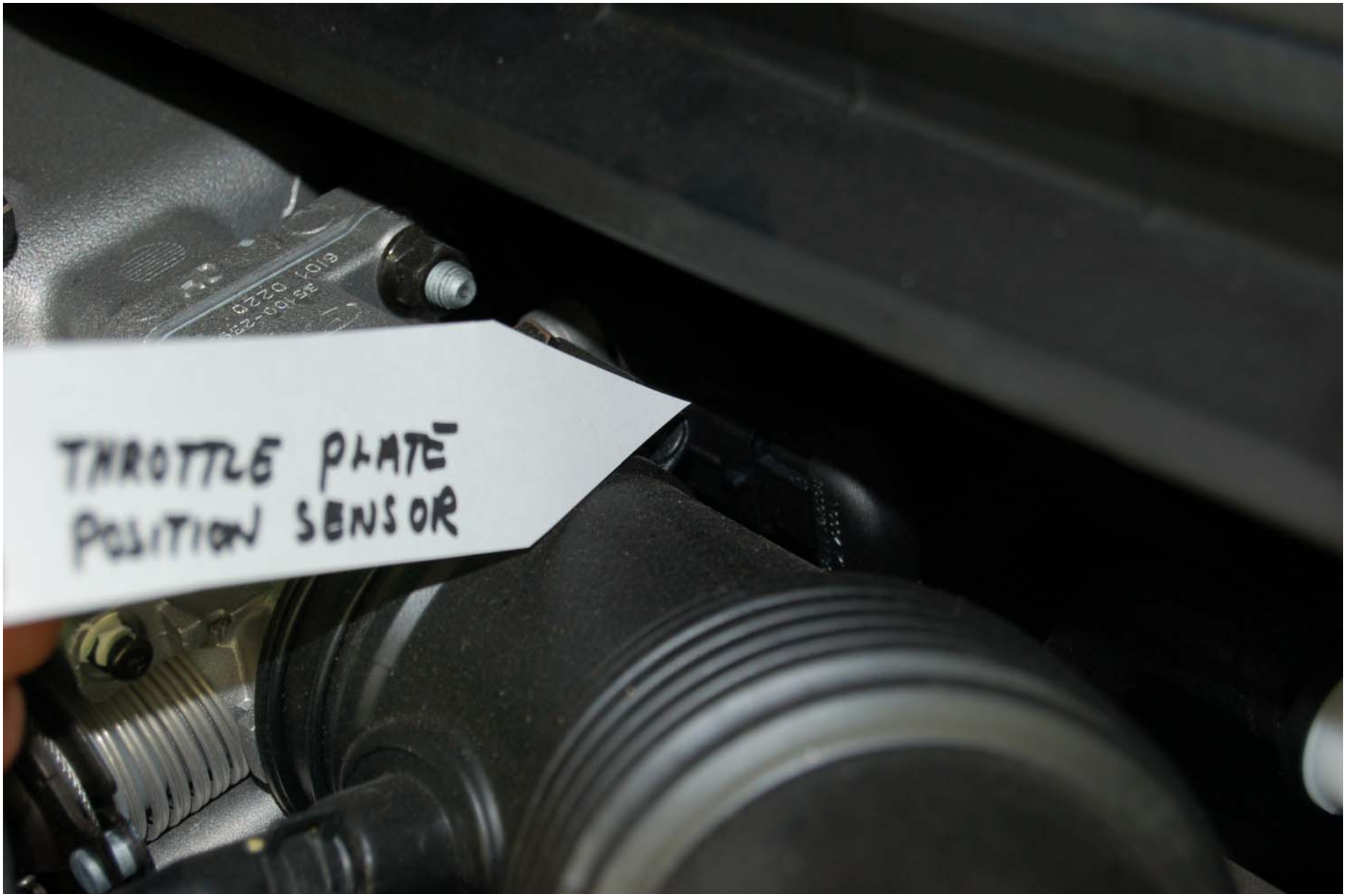
FIGURE 5.8
SPRING #1 CLOSE-UP VIEW

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.9
THROTTLE PLATE RETURN SPRINGS #2 AND #3 (VIEW #1)

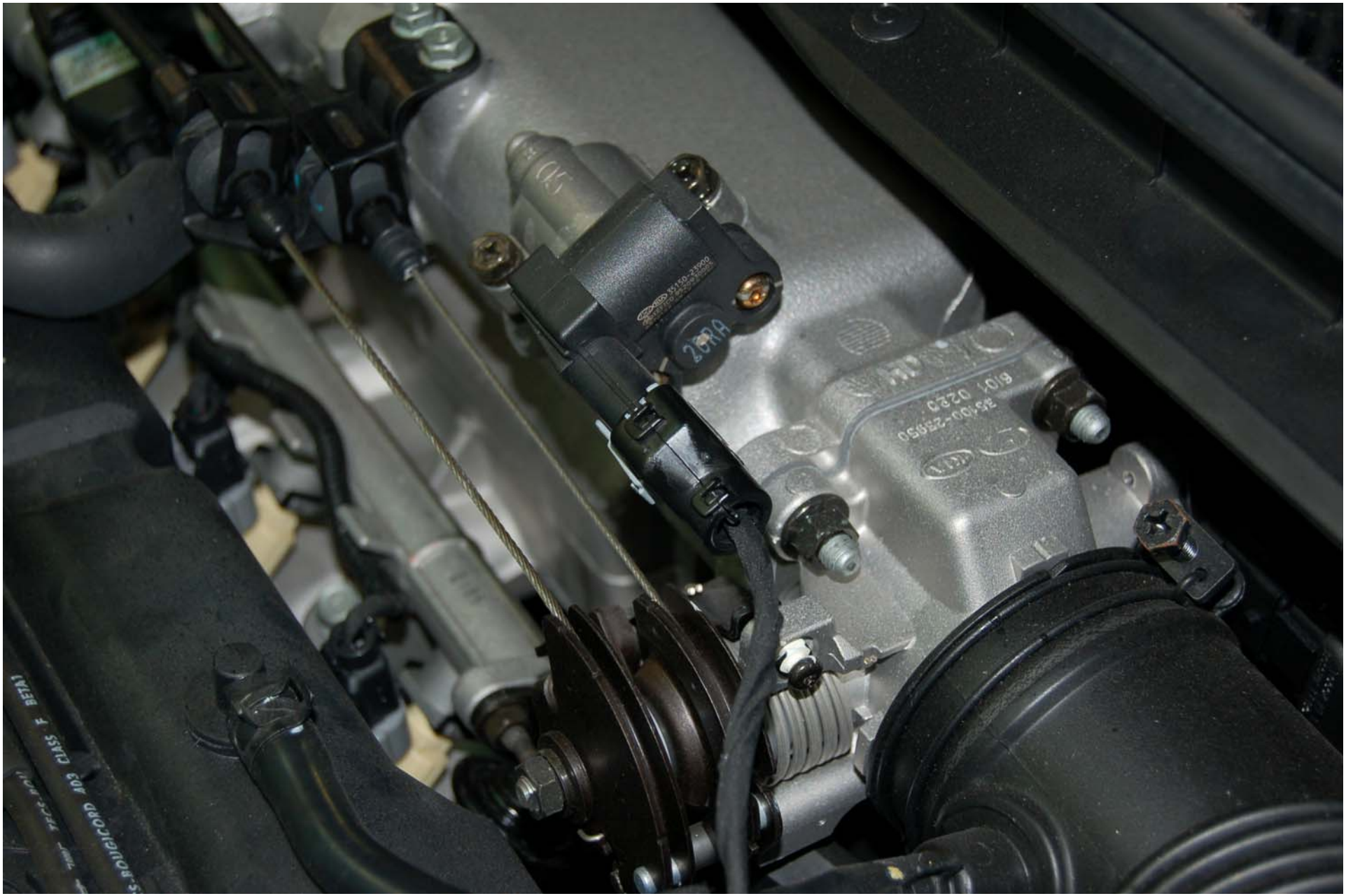
2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.10
THROTTLE PLATE RETURN SPRINGS #2 AND #3 (VIEW #2)



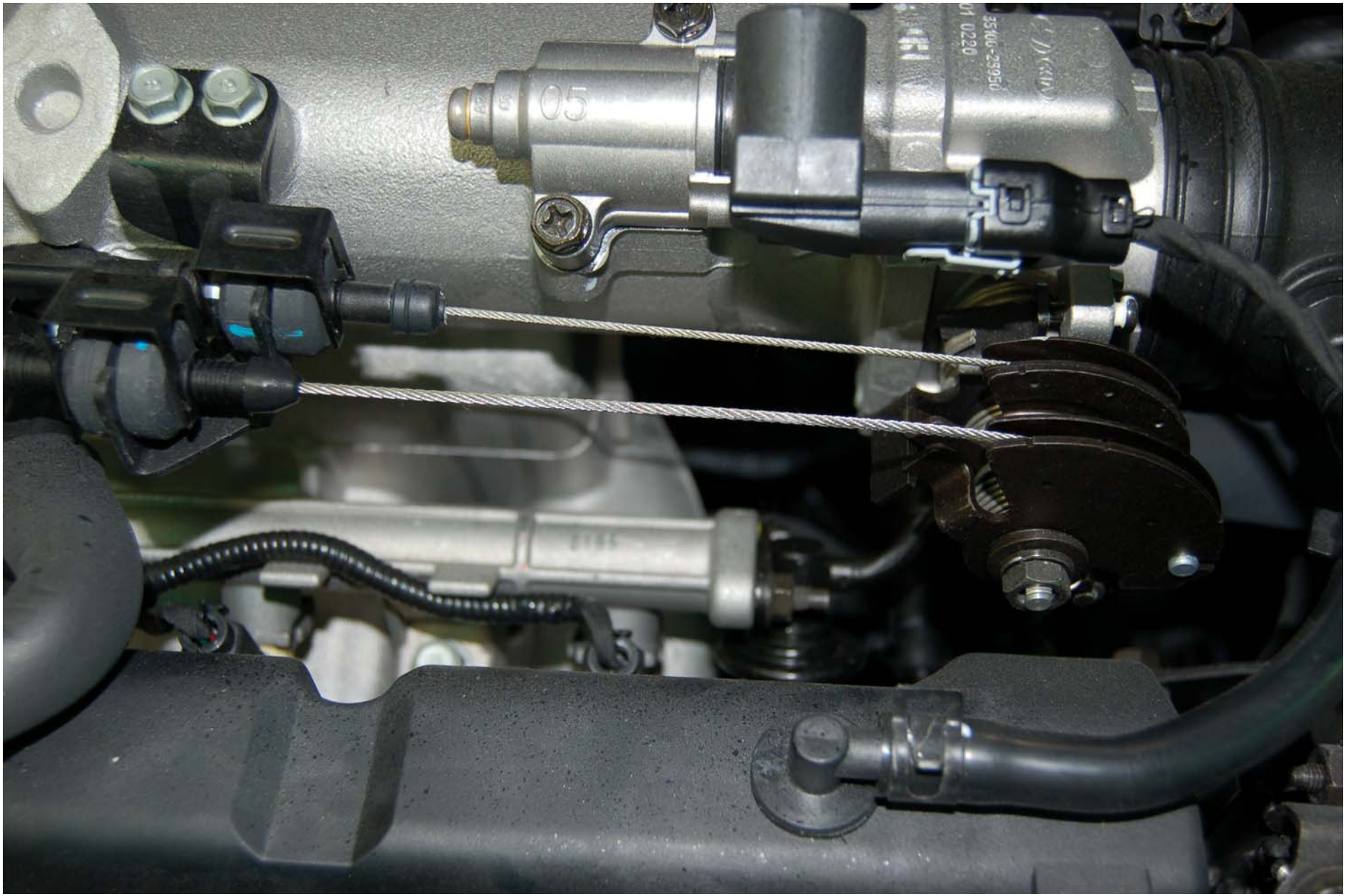
2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.11
THROTTLE PLATE POSITION SENSOR



2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.12
ACCELERATOR CABLE HOOK-UP (VIEW #1)



2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

FIGURE 5.13
ACCELERATOR CABLE HOOK-UP (VIEW #2)

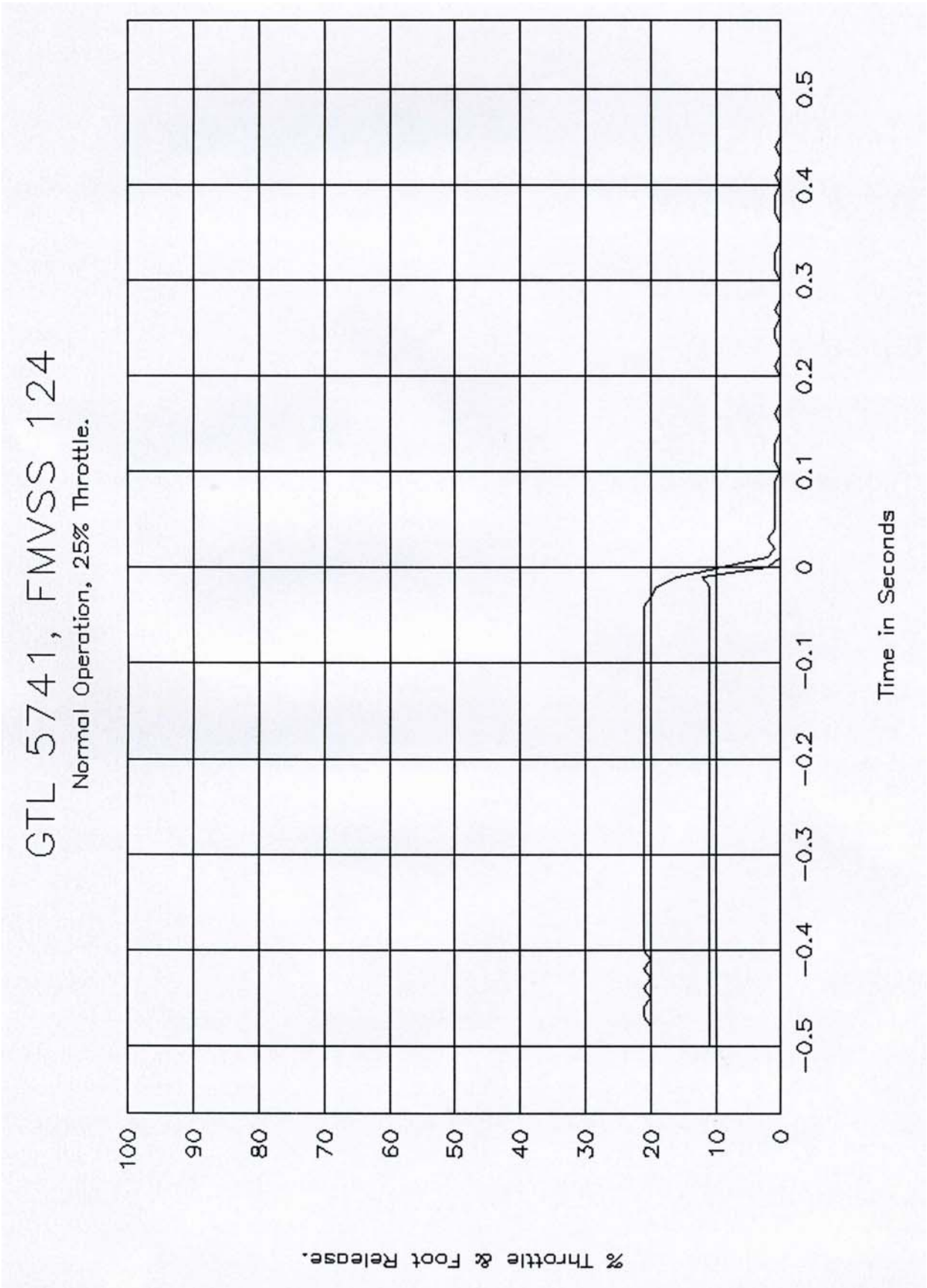
2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

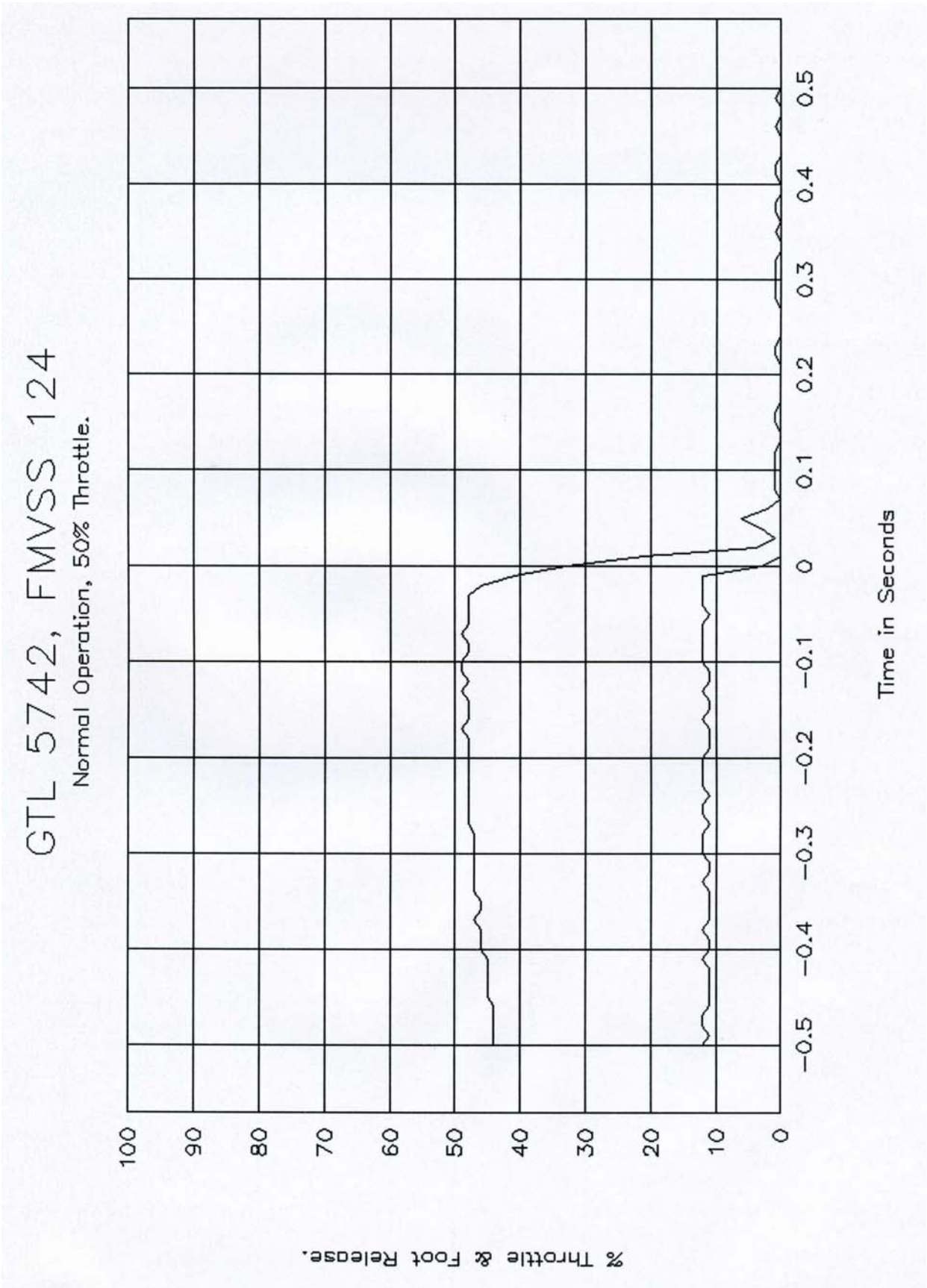
FIGURE 5.14
OVERALL TEST SET-UP

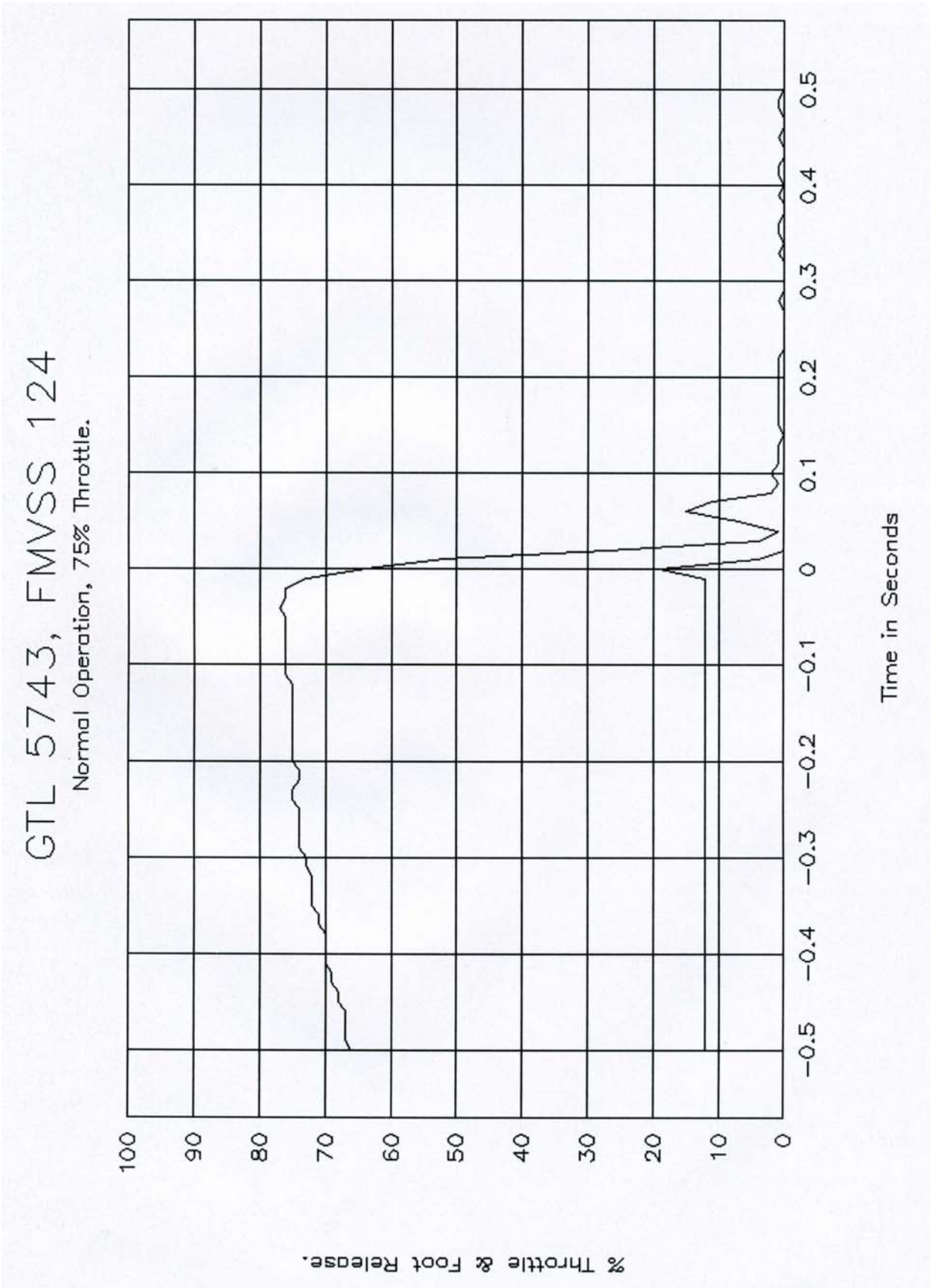
2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 124

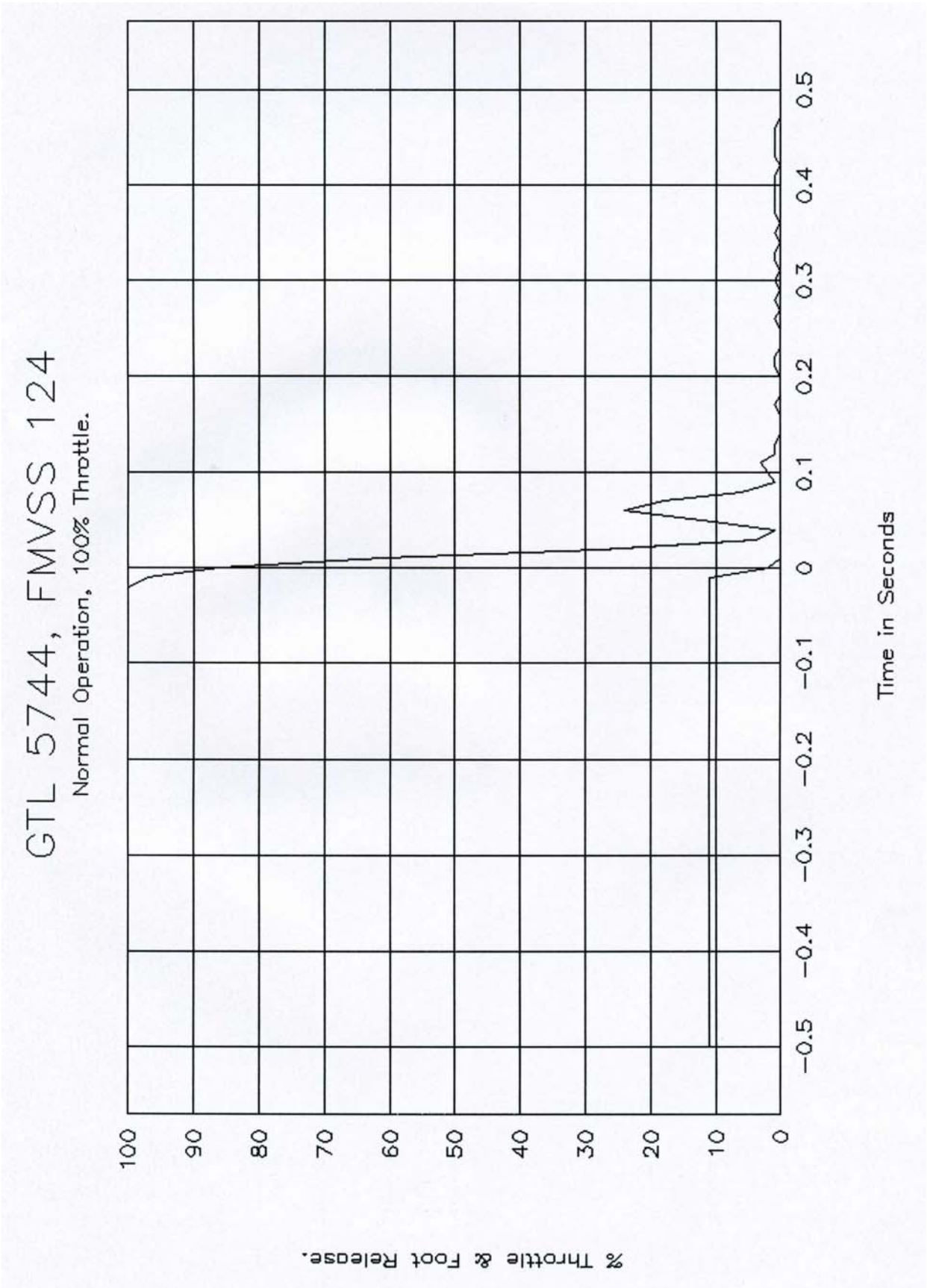
FIGURE 5.15
ACCELERATOR PEDAL TEST SET-UP

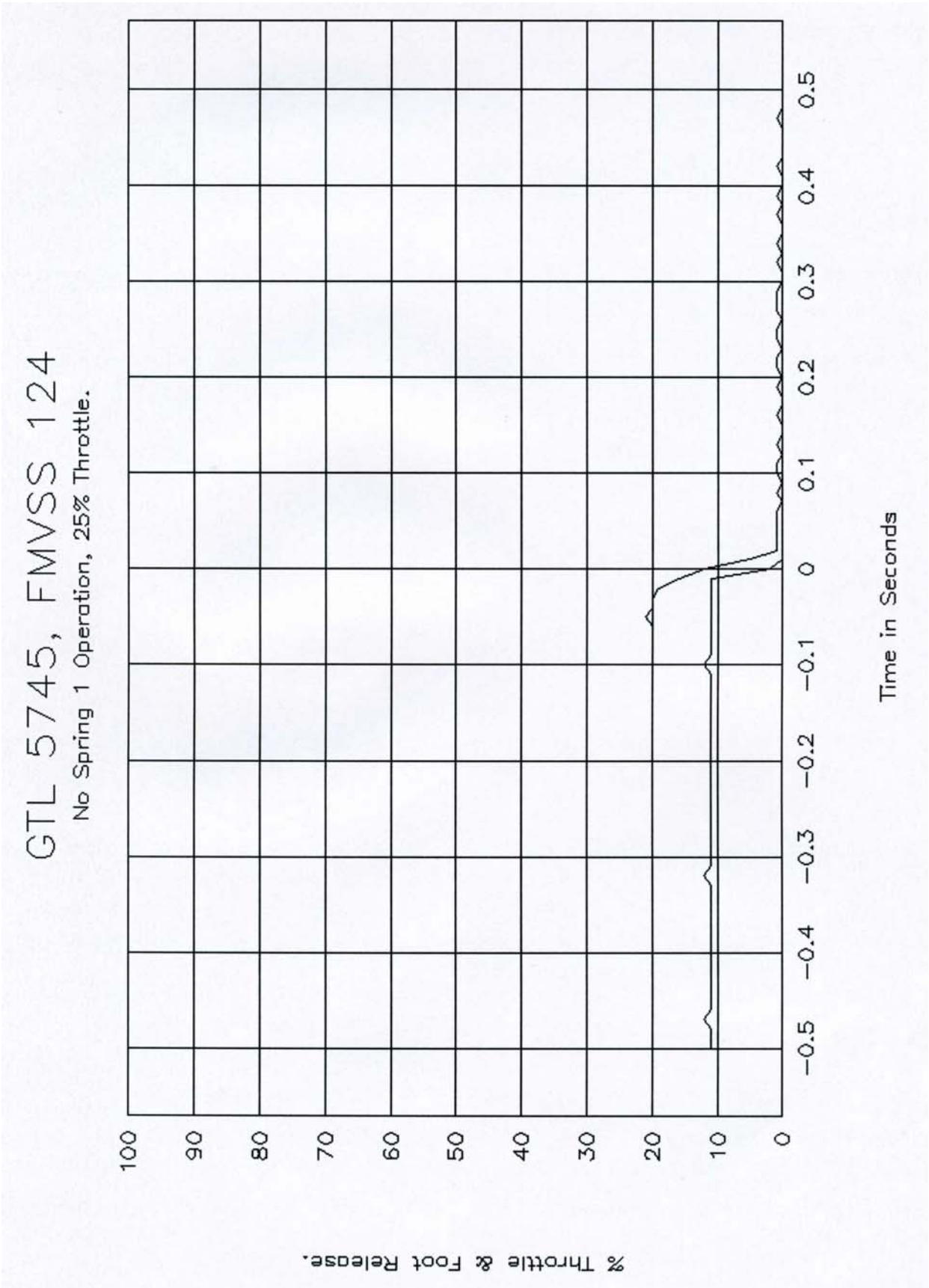
SECTION 6
PLOTS

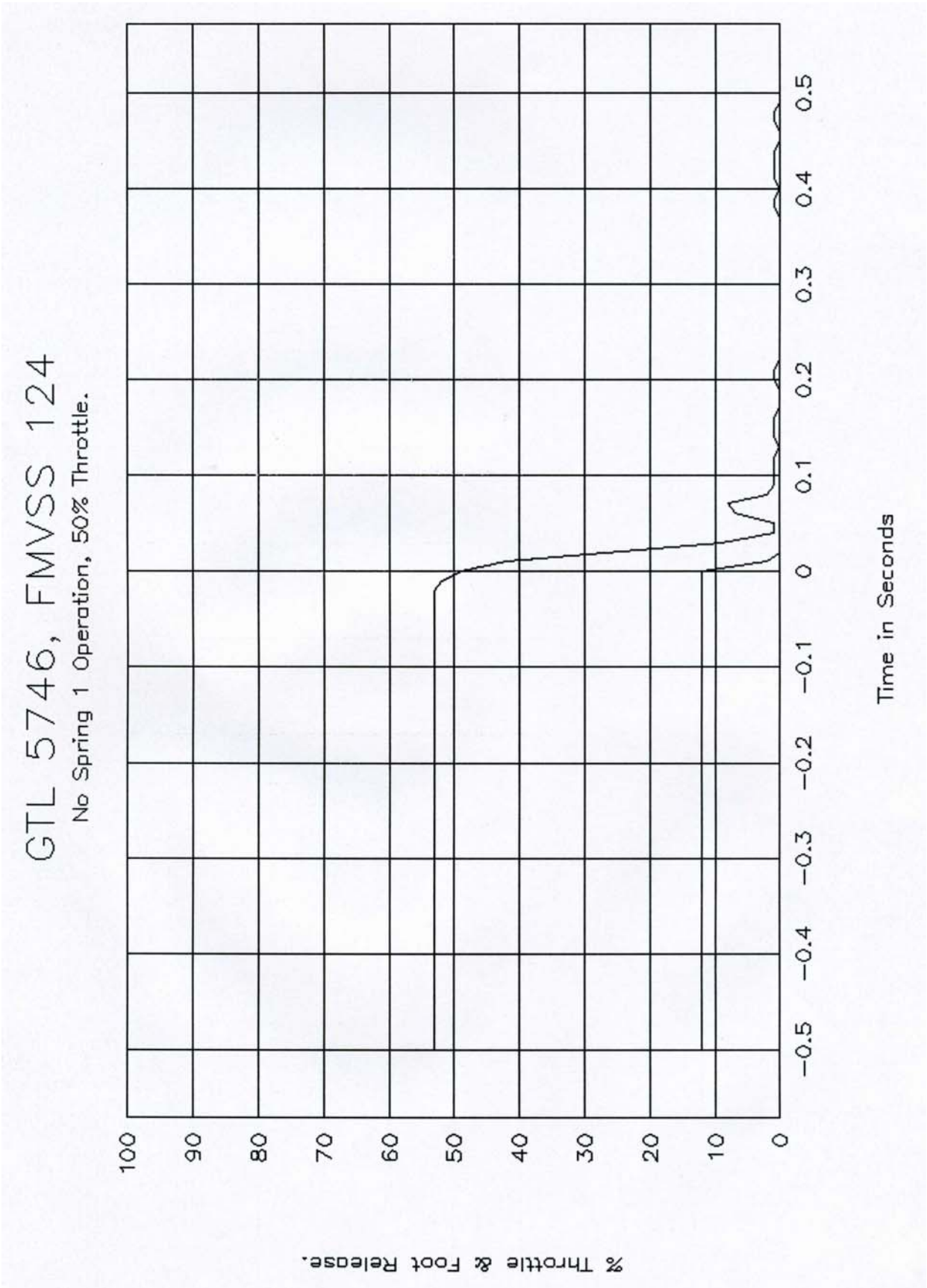

GTL 5741, FMVSS 124
Normal Operation, 25% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

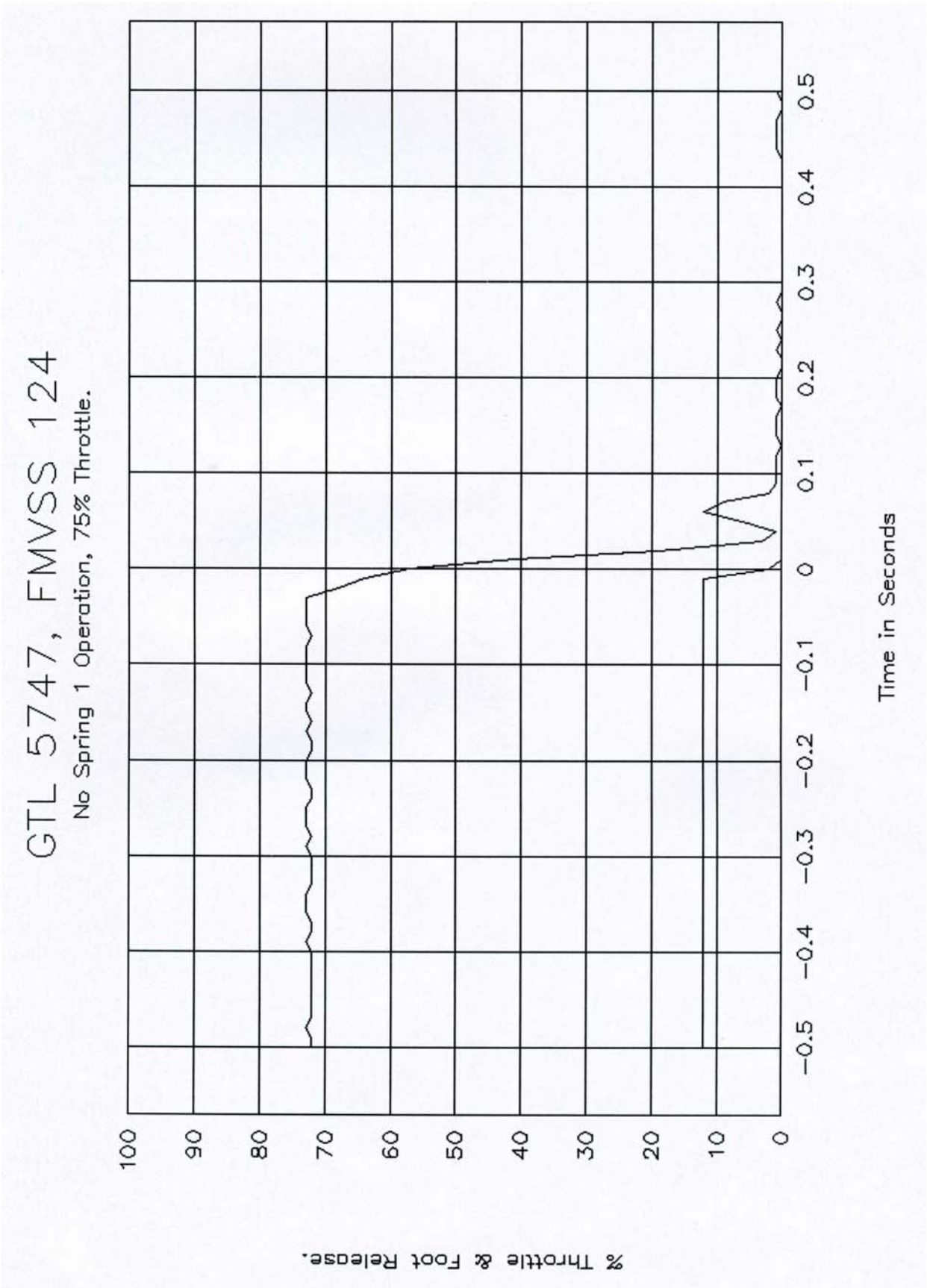

GTL 5742, FMVSS 124
Normal Operation, 50% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

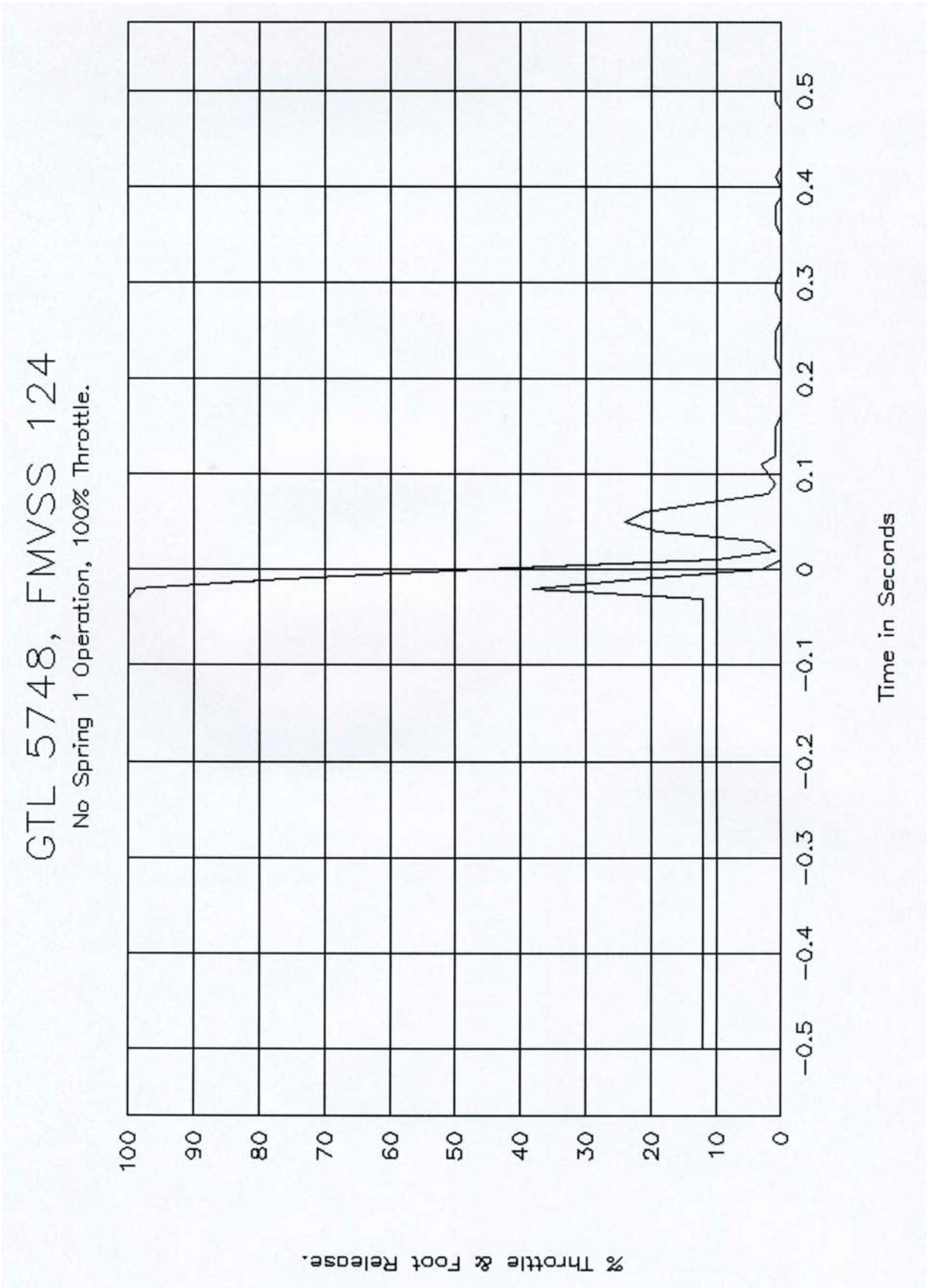

GTL 5743, FMVSS 124
Normal Operation, 75% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

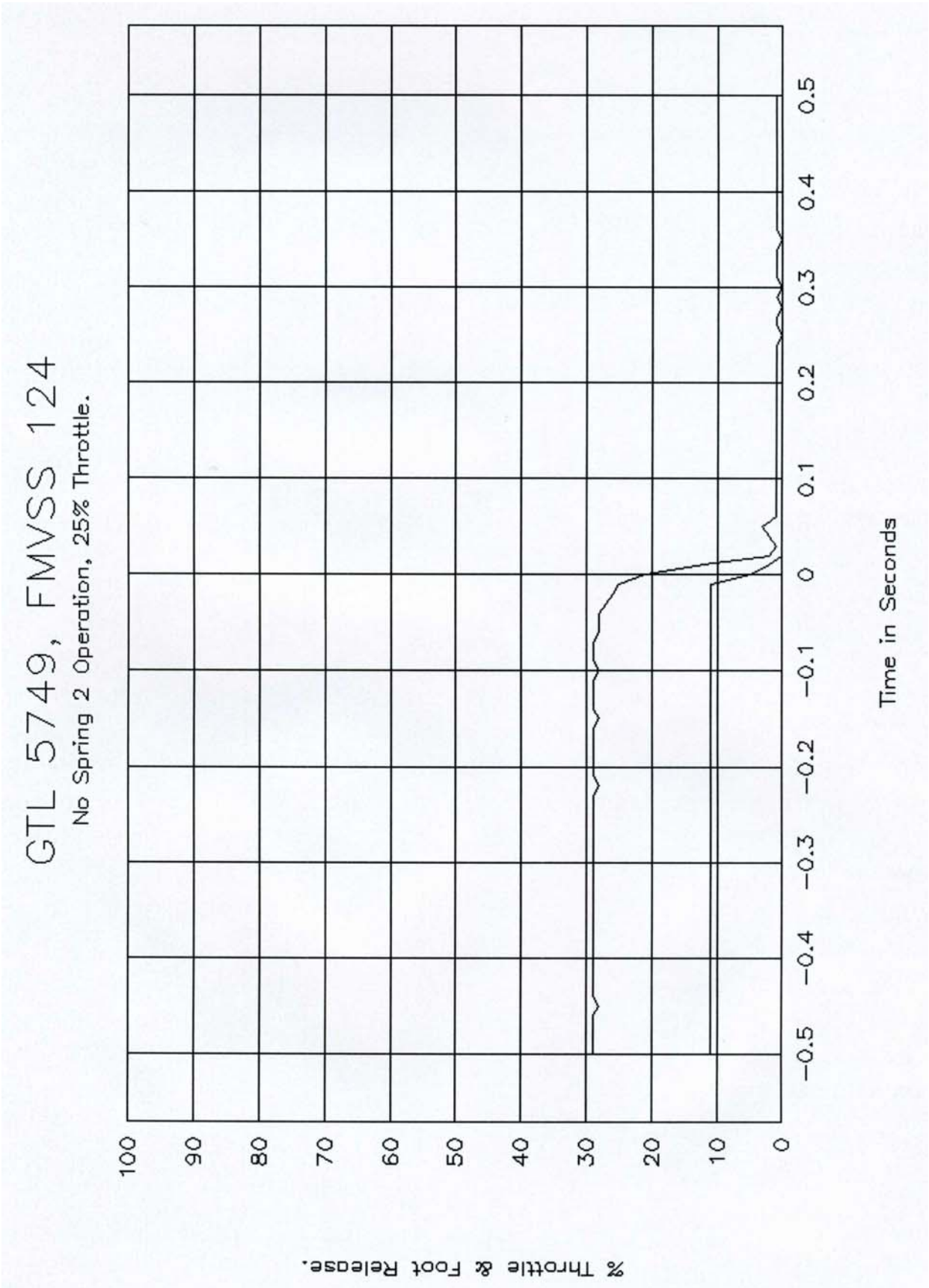

GTL 5744, FMVSS 124
Normal Operation, 100% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

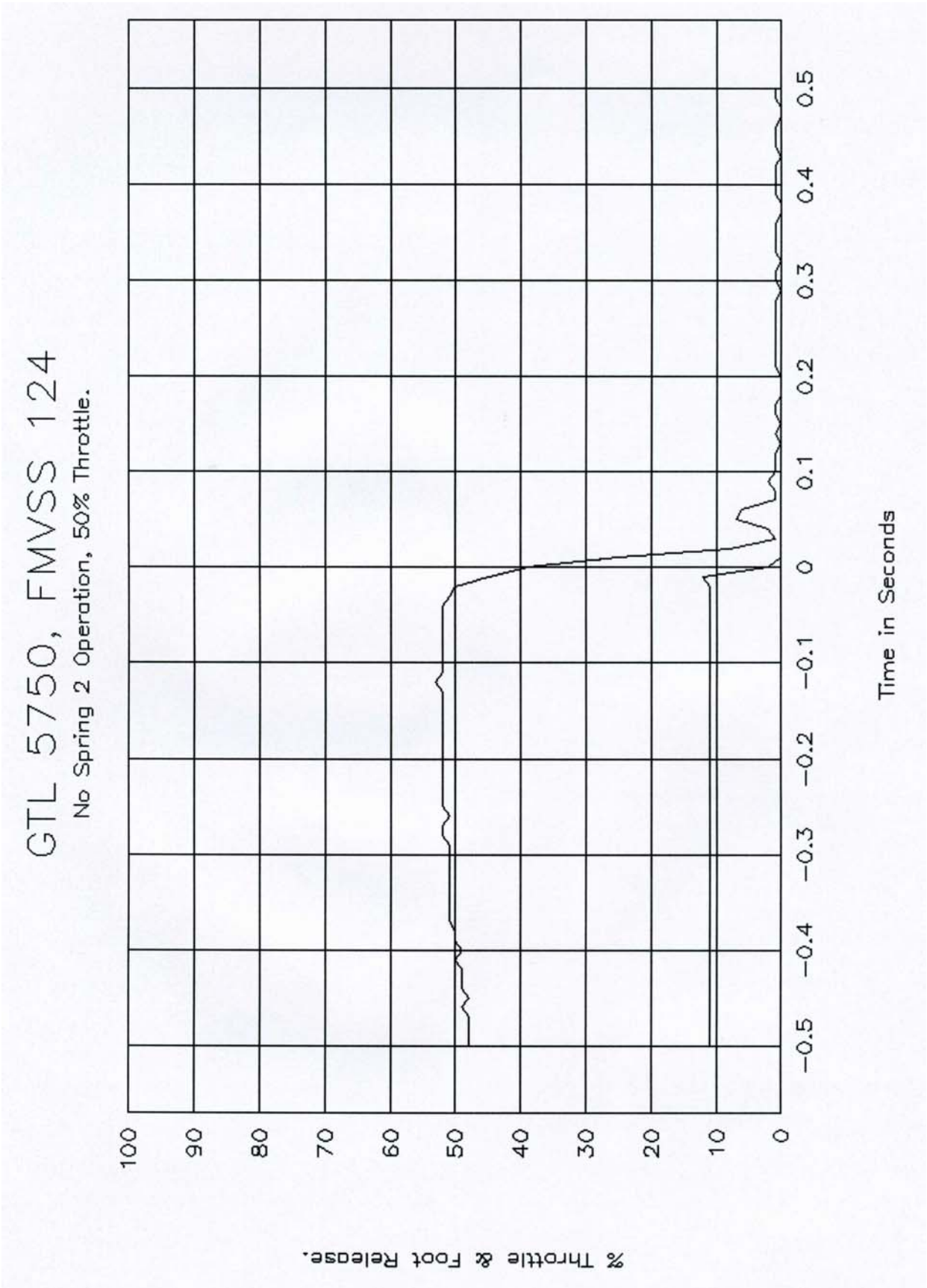

GTL 5745, FMVSS 124
No Spring 1 Operation, 25% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

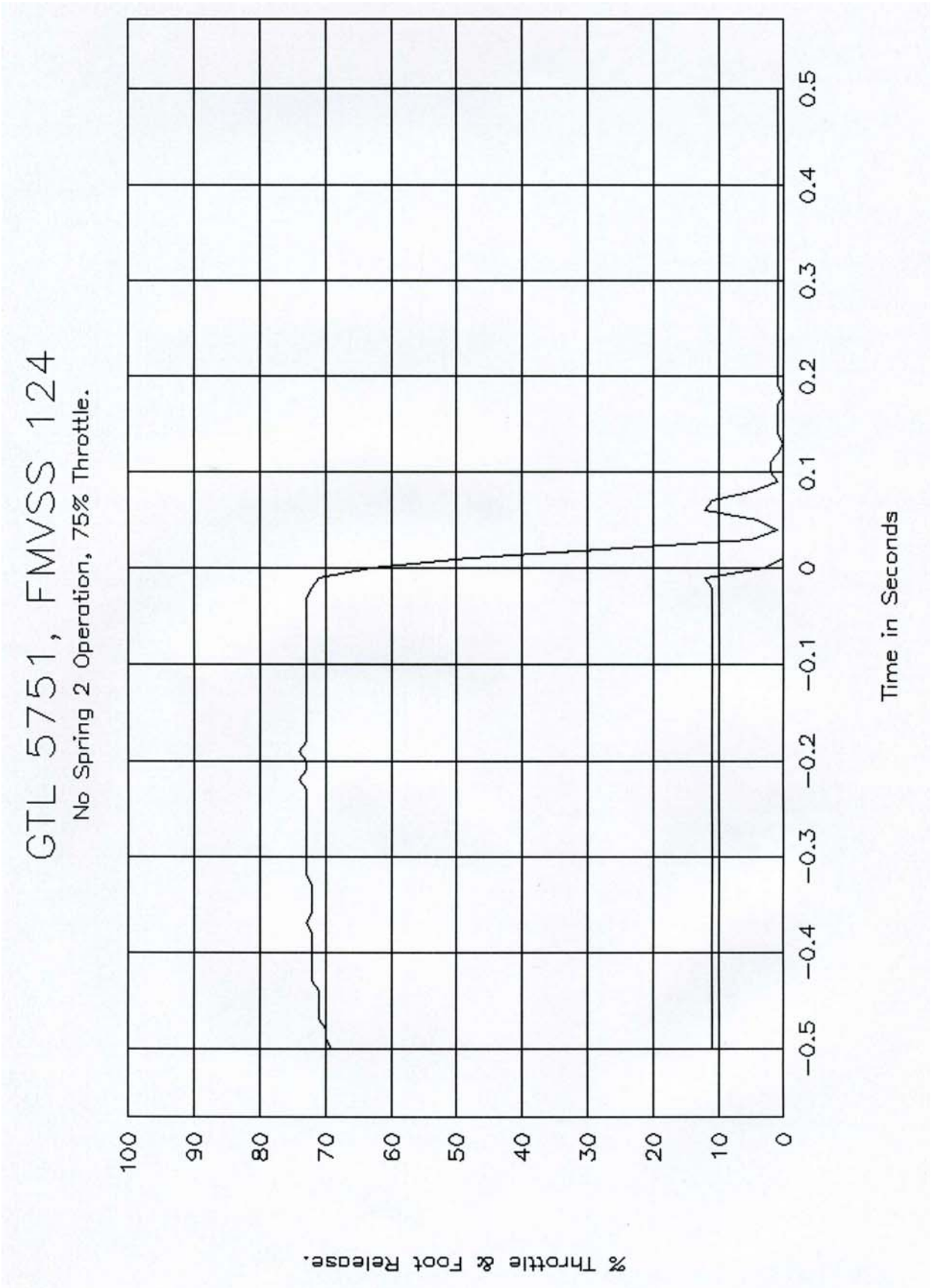

GTL 5746, FMVSS 124
No Spring 1 Operation, 50% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5747, FMVSS 124
No Spring 1 Operation, 75% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5748, FMVSS 124
No Spring 1 Operation, 100% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5749, FMVSS 124
No Spring 2 Operation, 25% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5750, FMVSS 124
No Spring 2 Operation, 50% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5751, FMVSS 124
No Spring 2 Operation, 75% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
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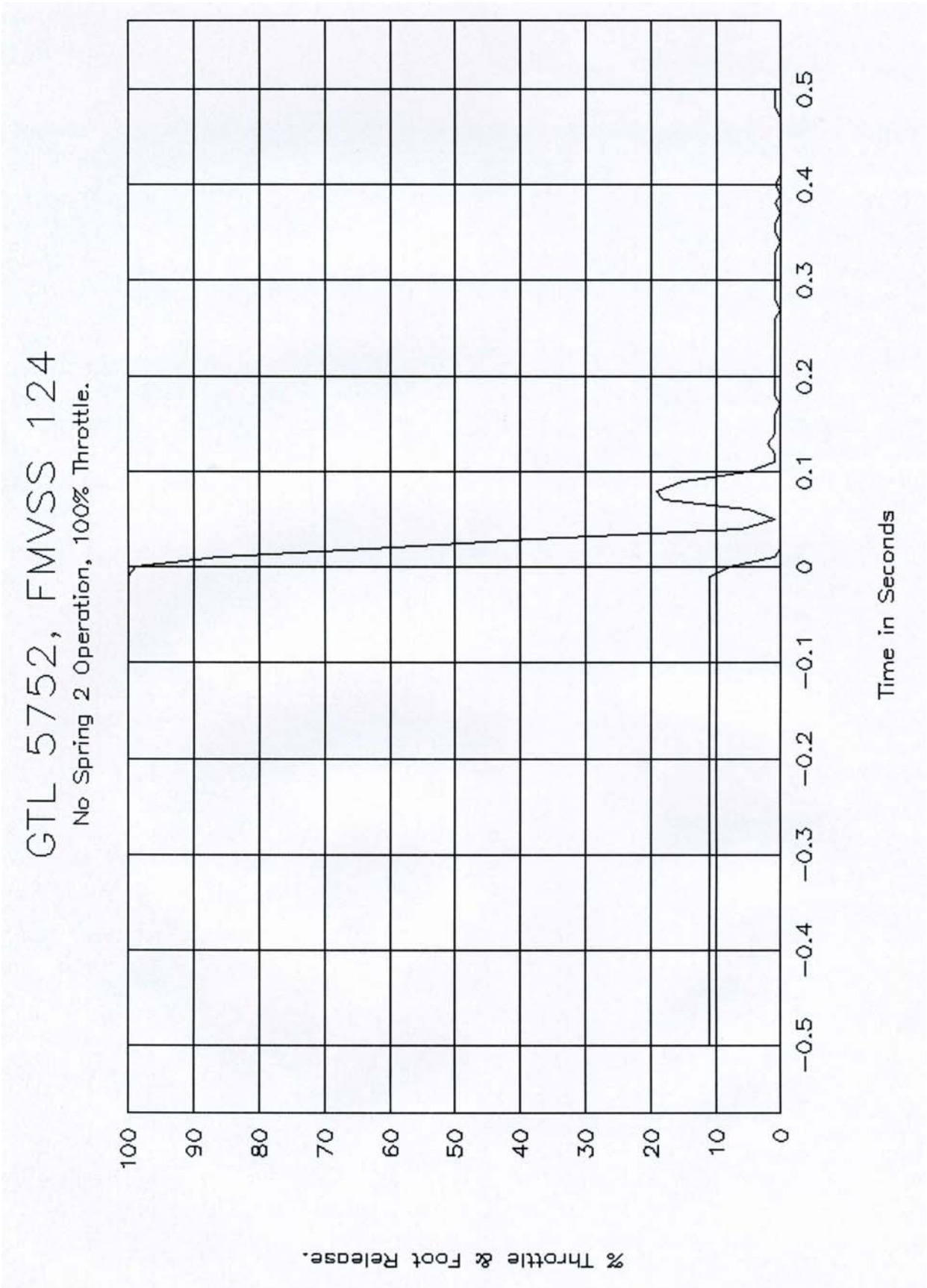
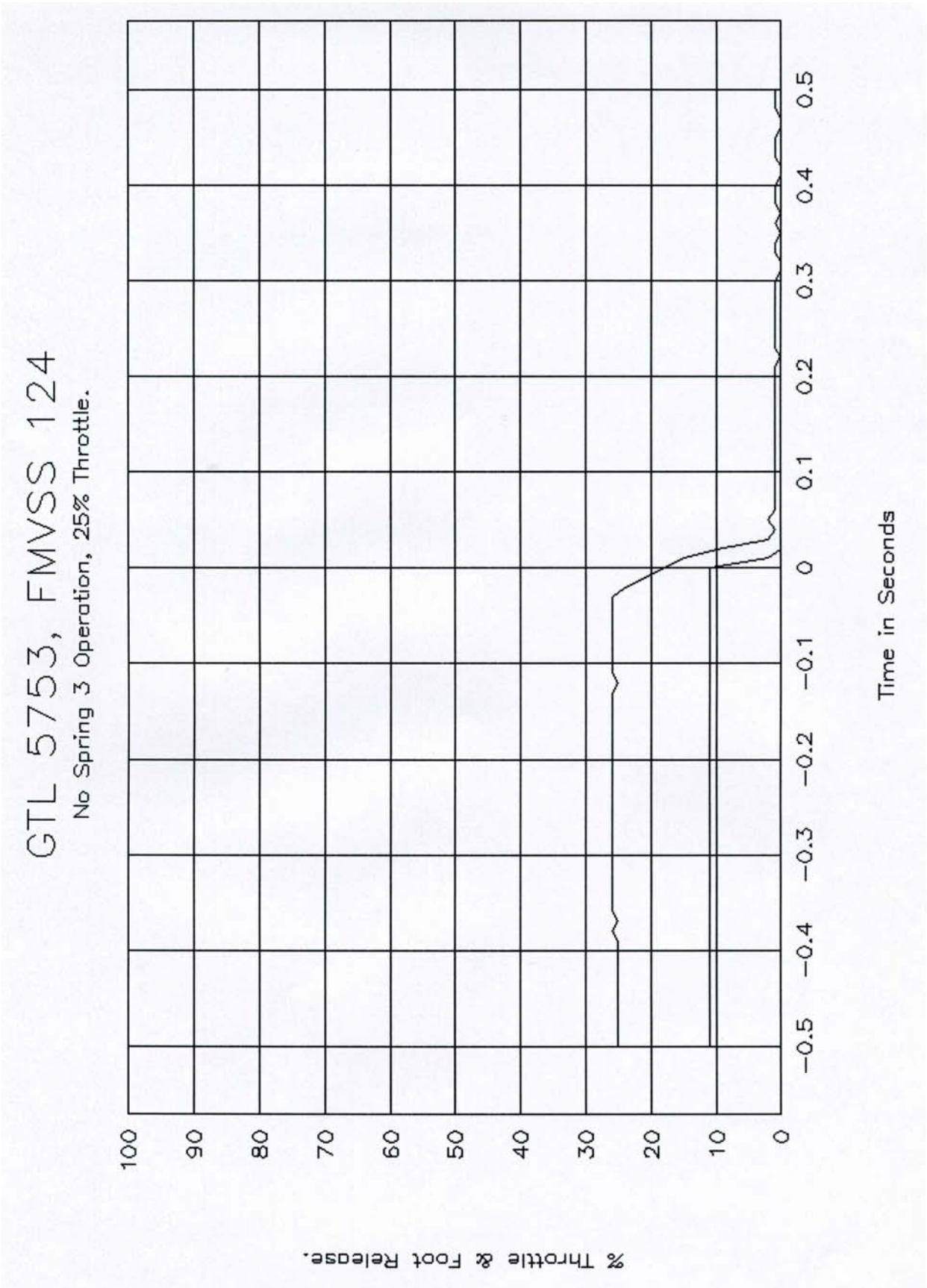
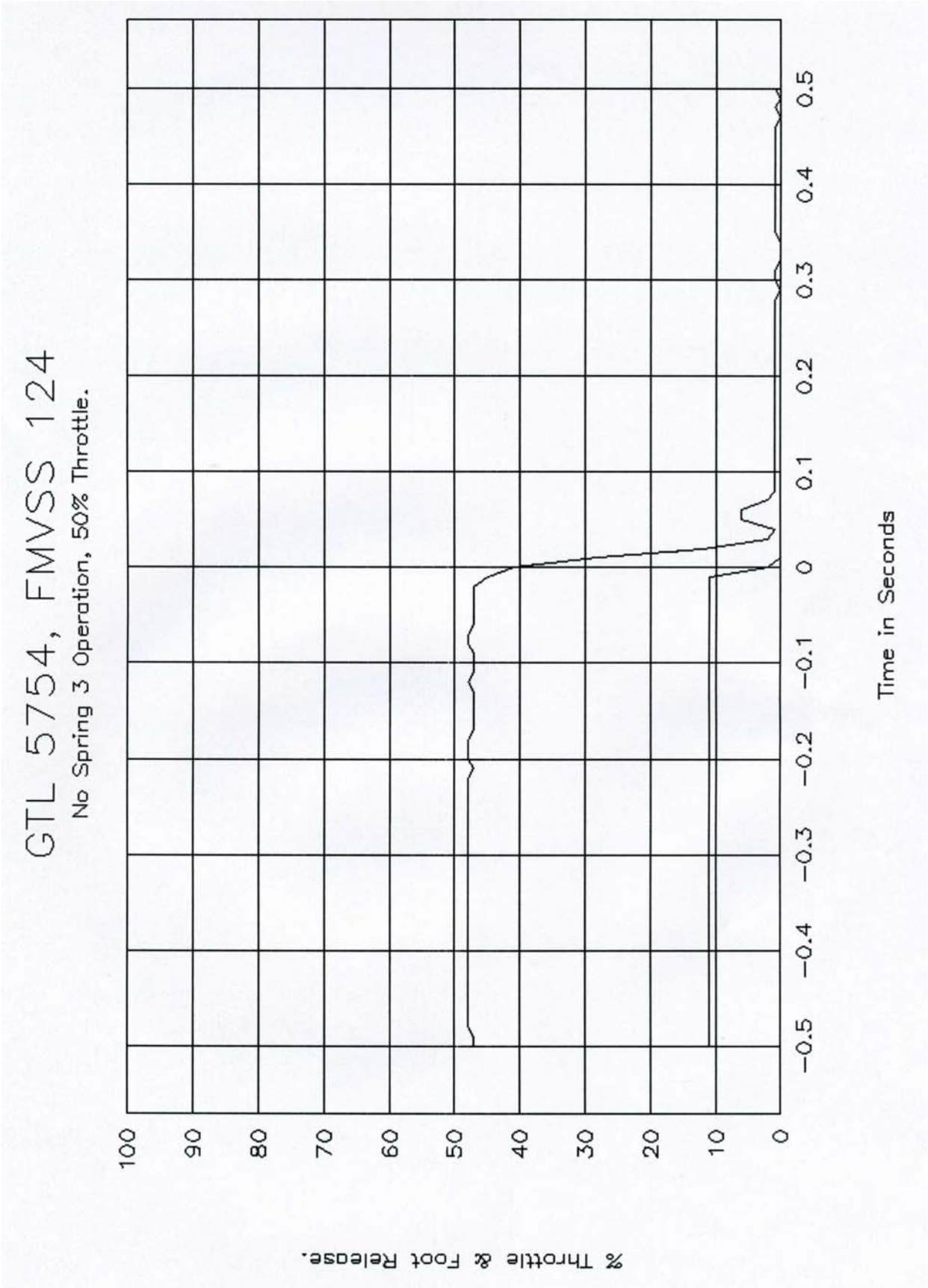
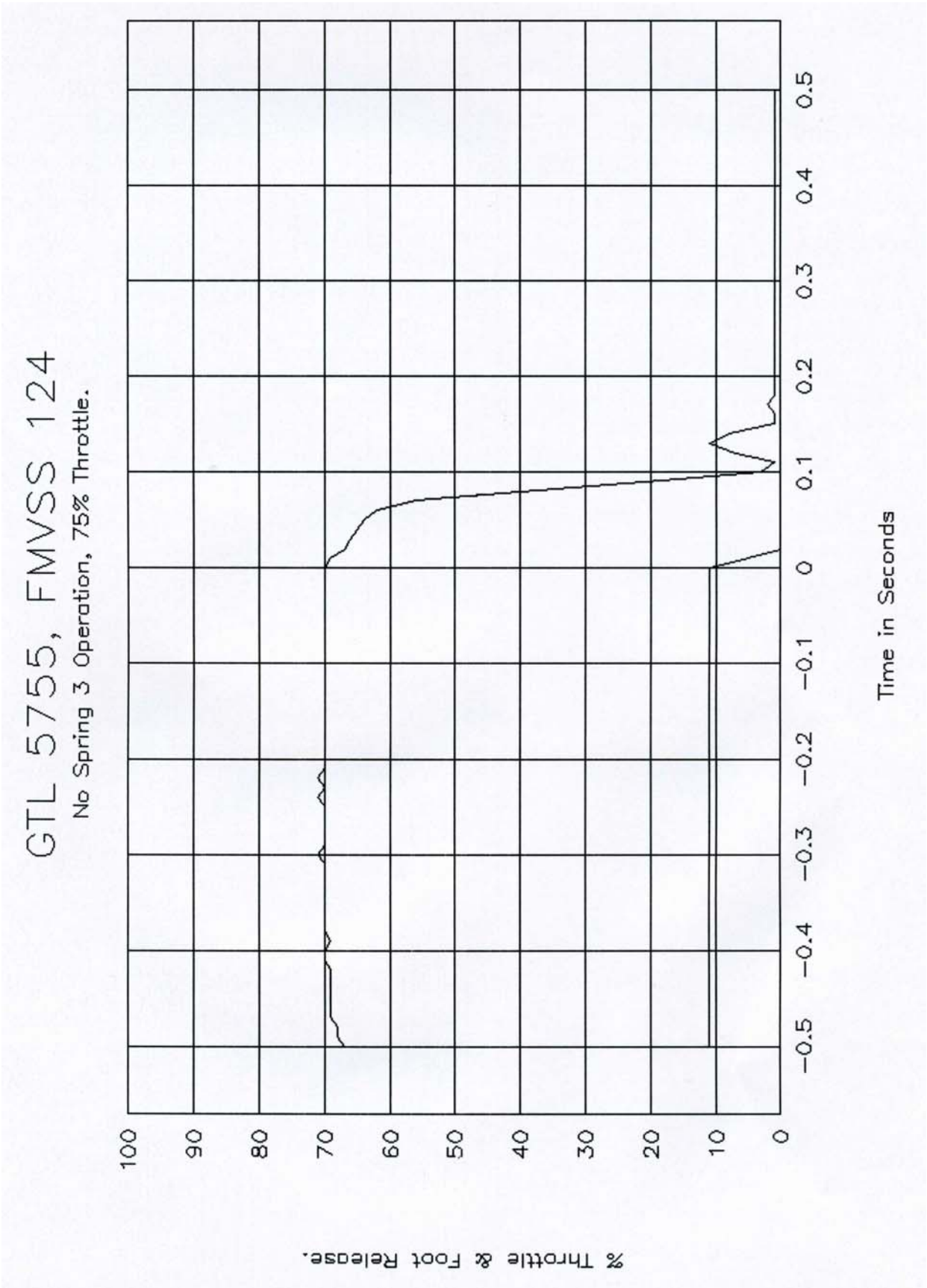
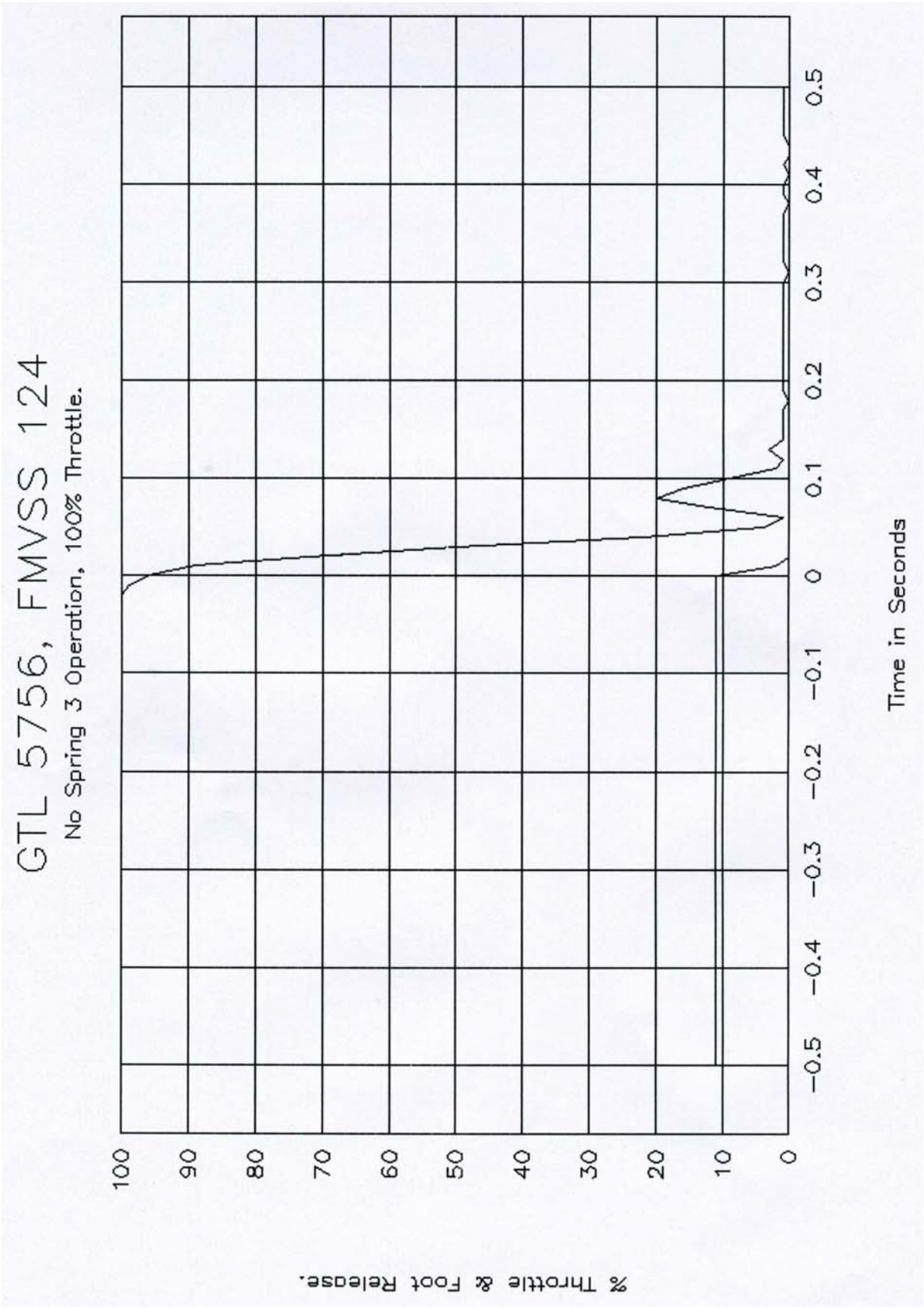
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

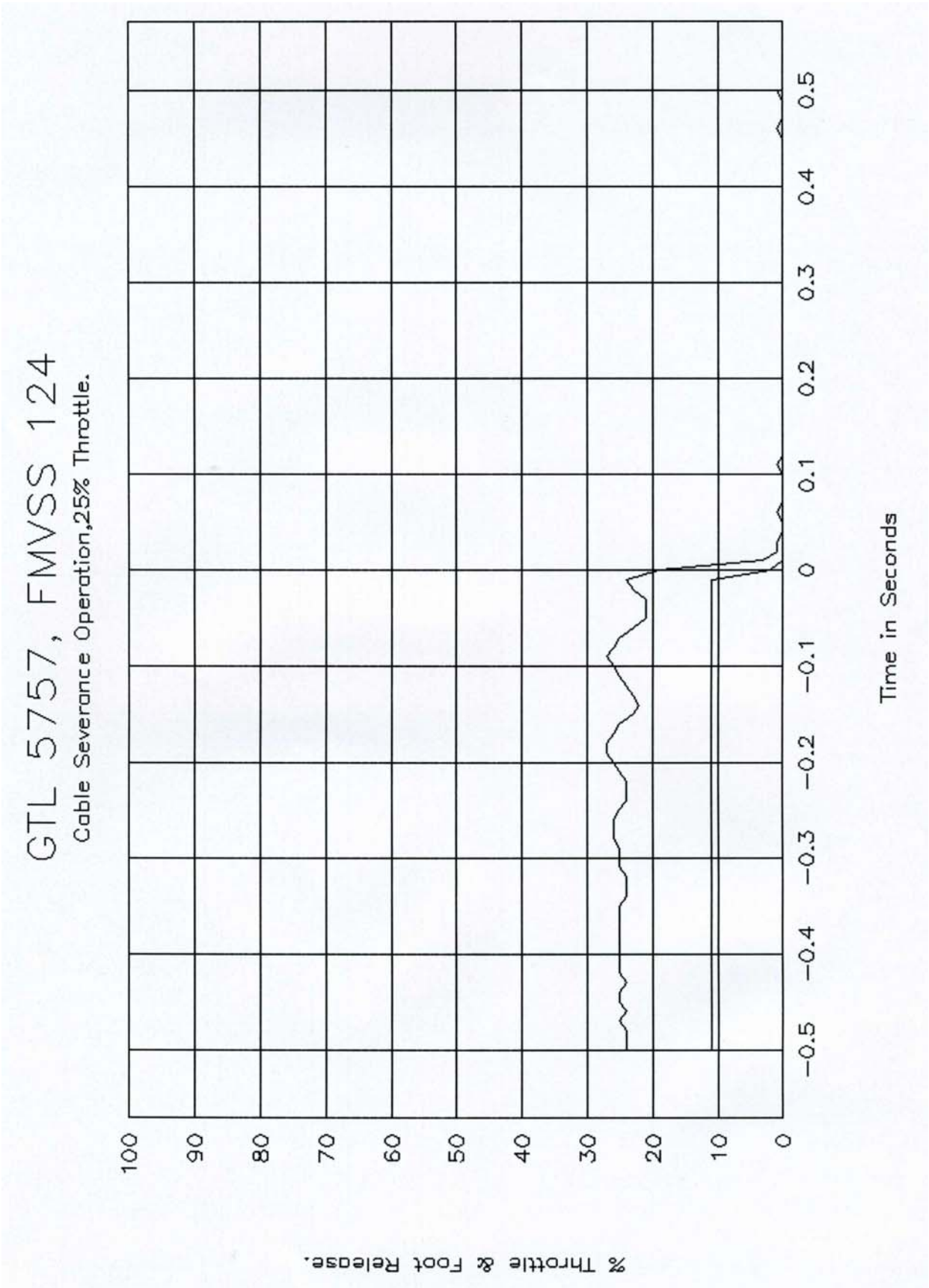

GTL 5752, FMVSS 124
No Spring 2 Operation, 100% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

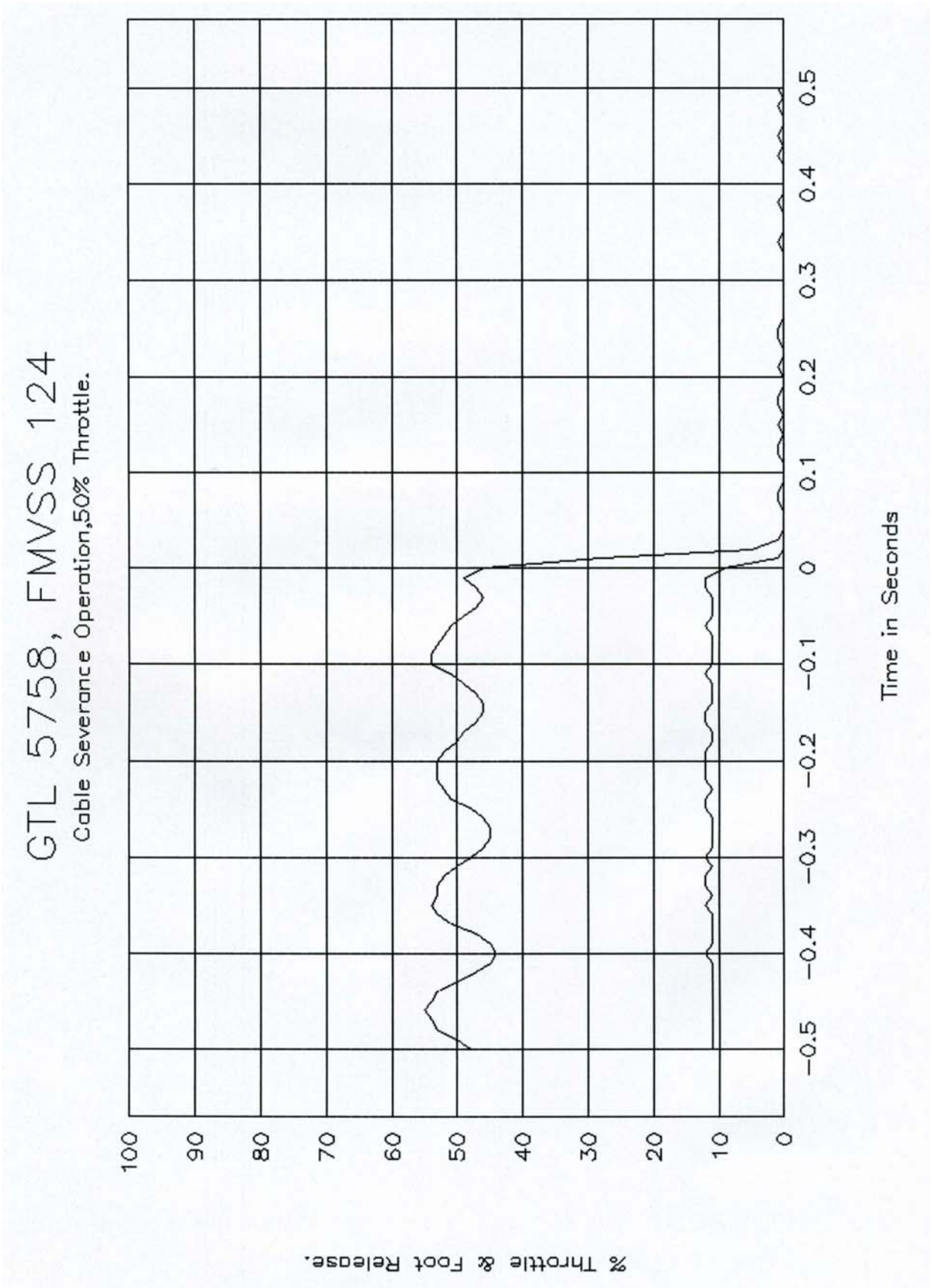

GTL 5753, FMVSS 124
No Spring 3 Operation, 25% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

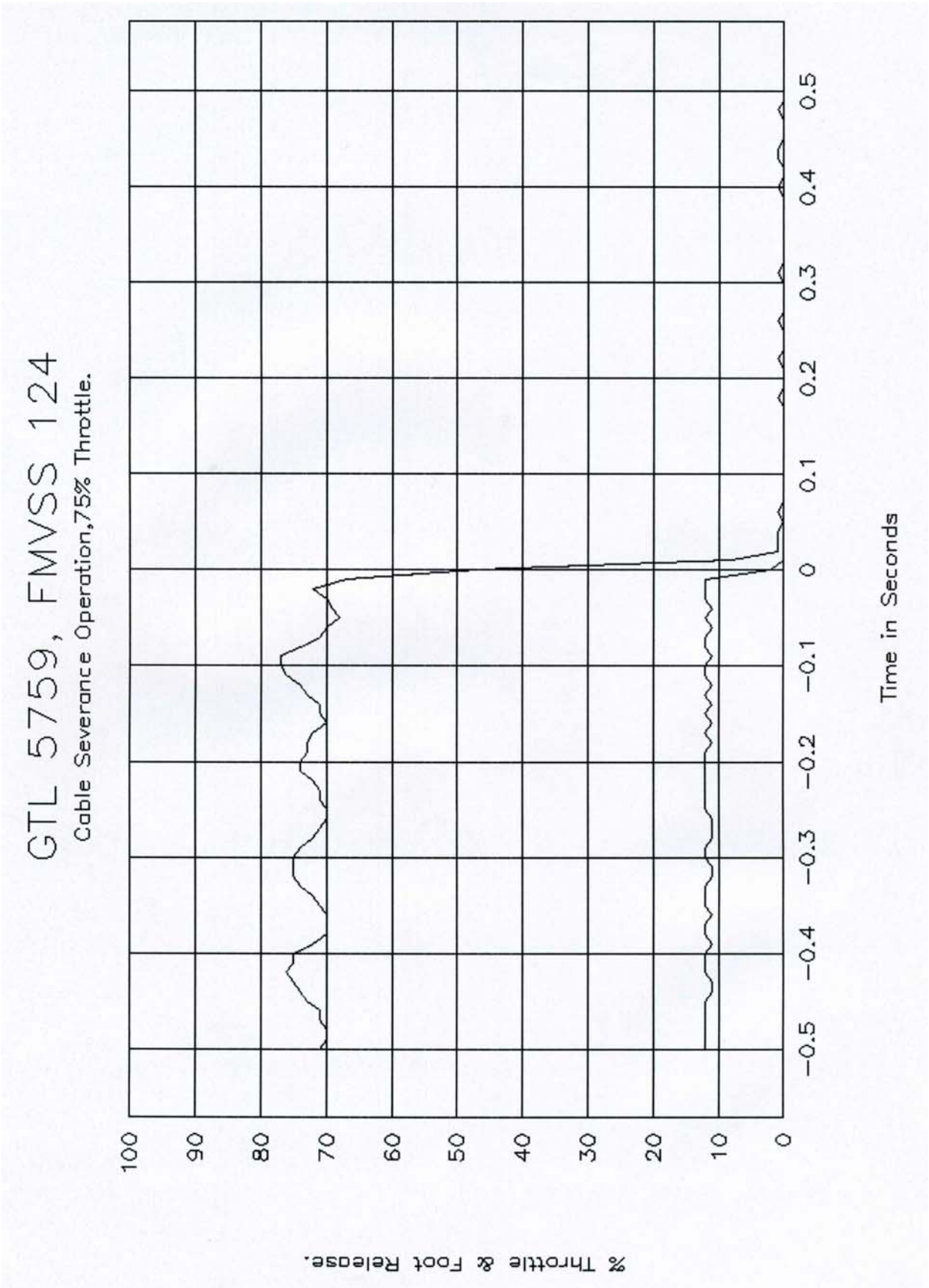

GTL 5754, FMVSS 124
No Spring 3 Operation, 50% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

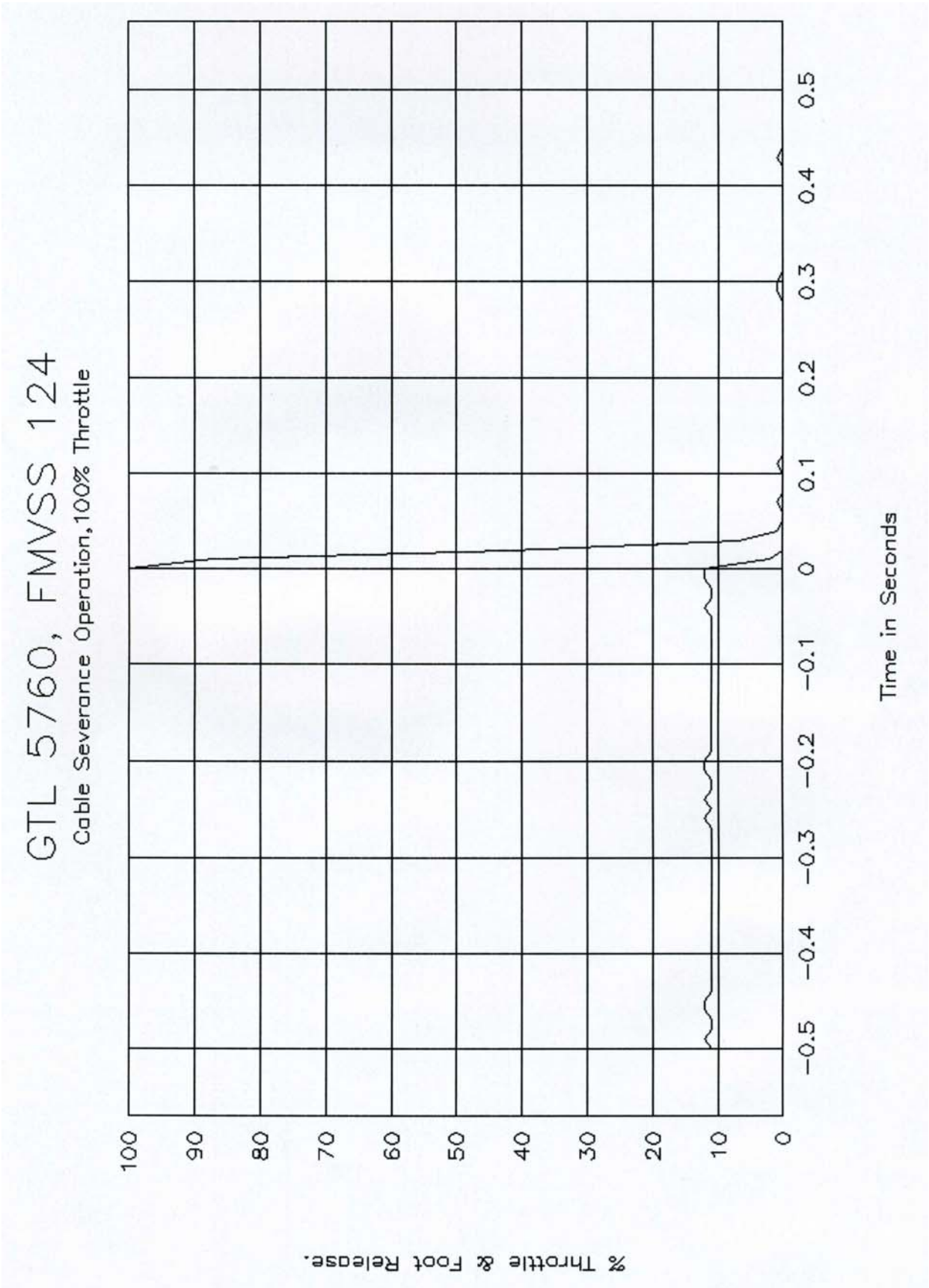

GTL 5755, FMVSS 124
No Spring 3 Operation, 75% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5756, FMVSS 124
No Spring 3 Operation, 100% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5757, FMVSS 124
Cable Severance Operation,25% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5758, FMVSS 124
Cable Severance Operation,50% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

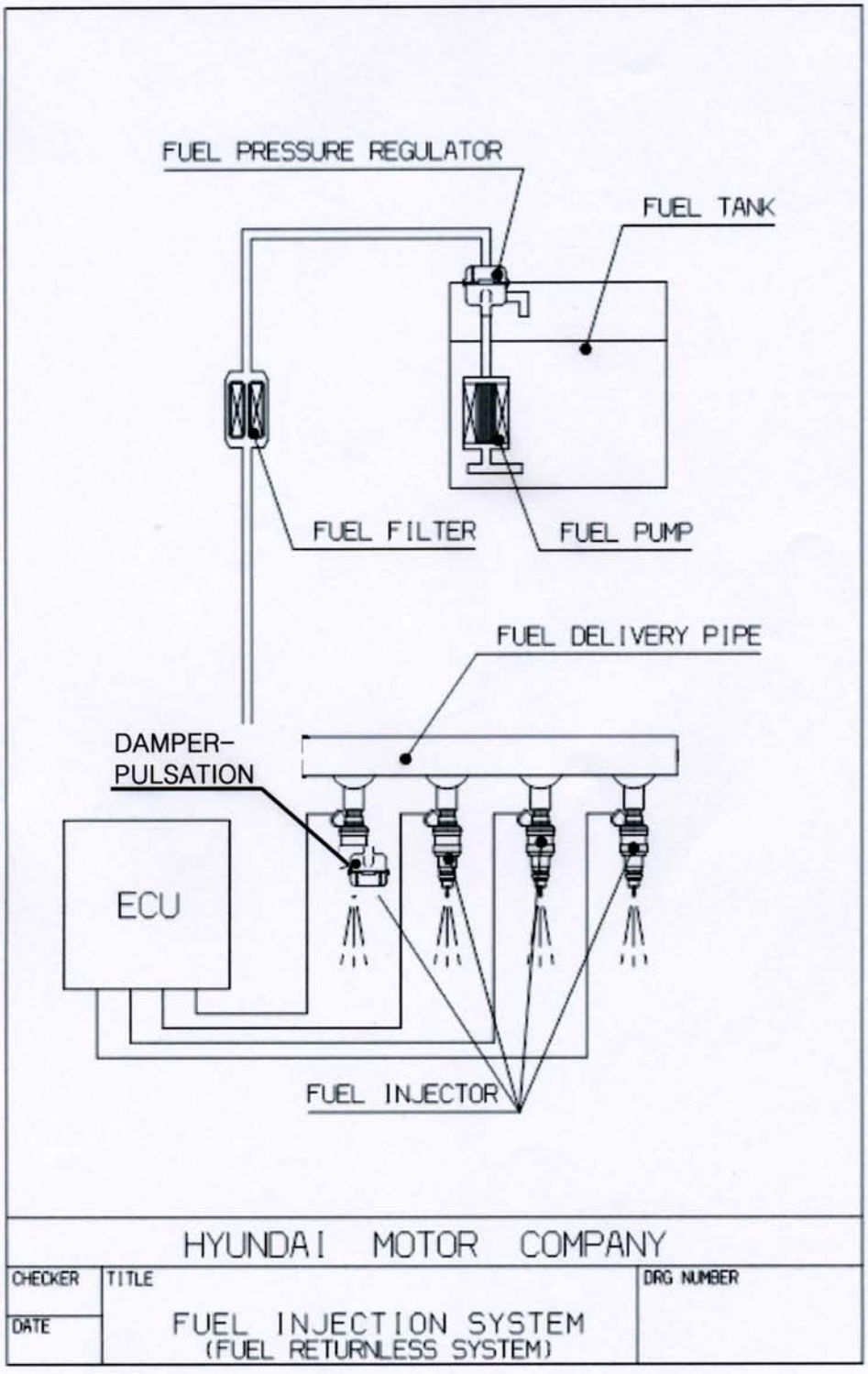

GTL 5759, FMVSS 124
Cable Severance Operation,75% Throttle.
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds


GTL 5760, FMVSS 124
Cable Severance Operation, 100% Throttle
% Throttle & Foot Release.
100
90
80
70
60
50
40
30
20
10
0
−0.5
−0.4
−0.3
−0.2
−0.1
0
0.1
0.2
0.3
0.4
0.5
Time in Seconds

SECTION 7
MANUFACTURER'S DRAWINGS

07MY Hyundai Elantra FMVSS 124

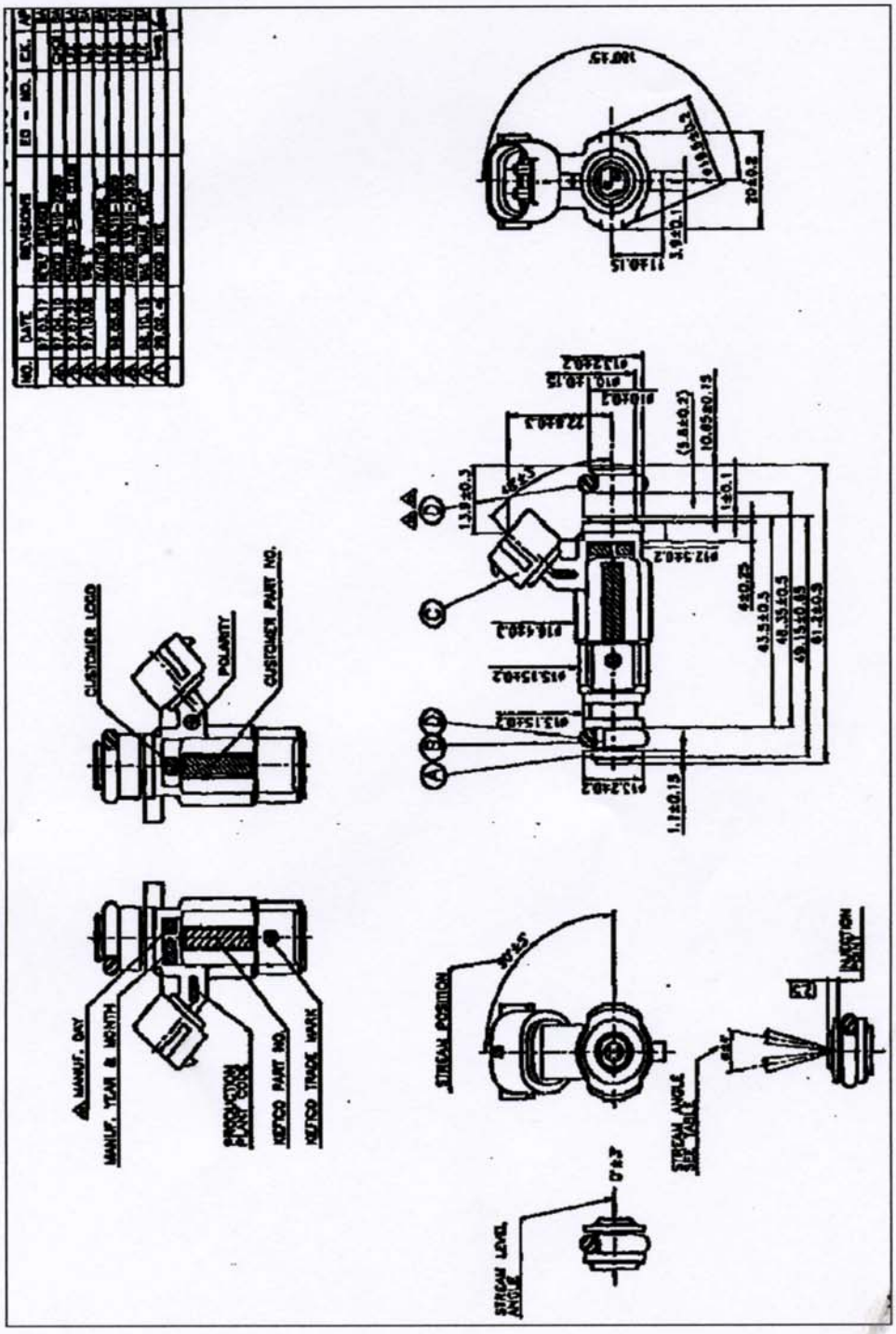
1. Injection system diagram



ATTACHMENT 1

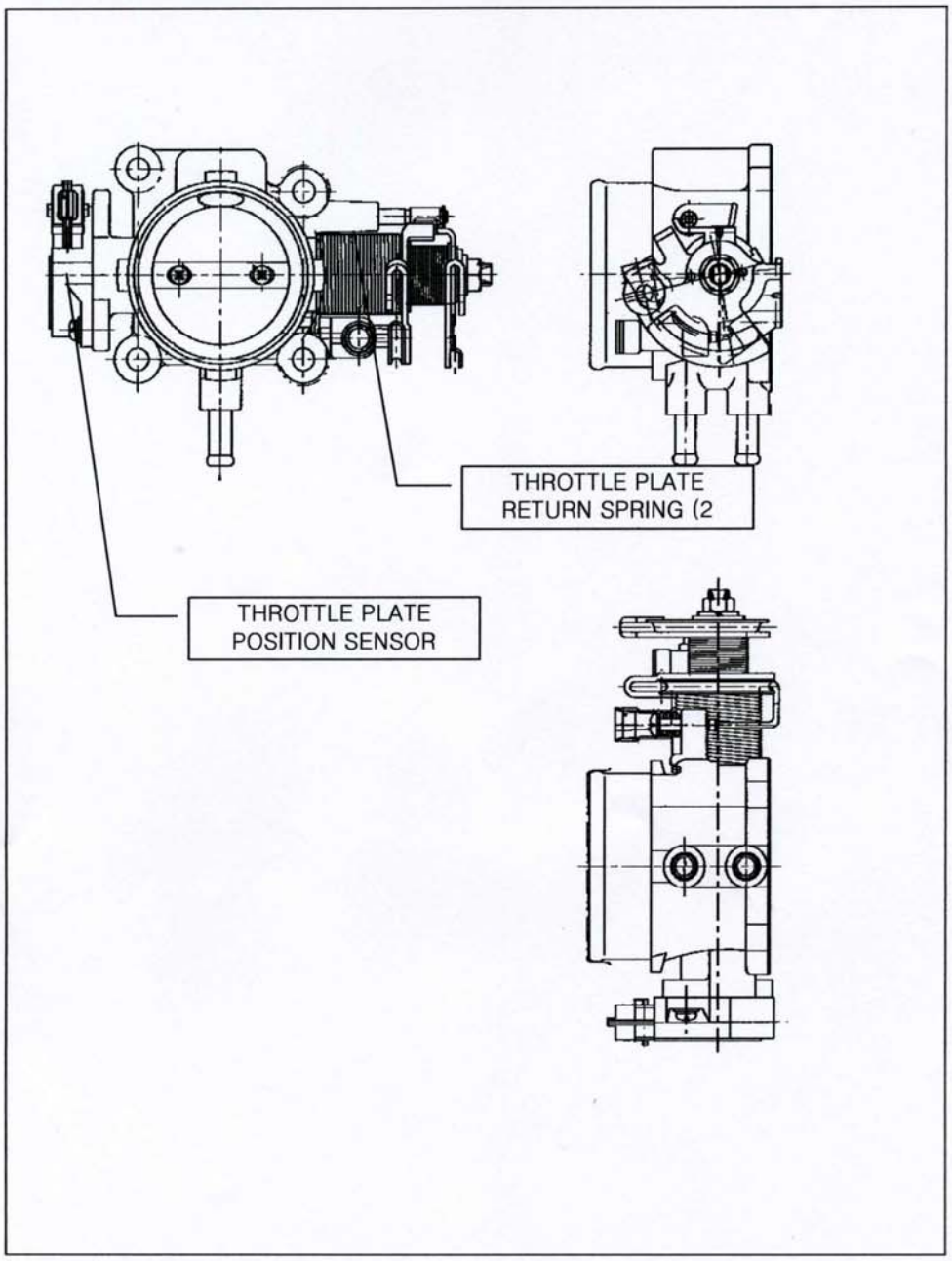
07MY Hyundai Elantra FMVSS 124

2. Injector drawing



ATTACHMENT 1

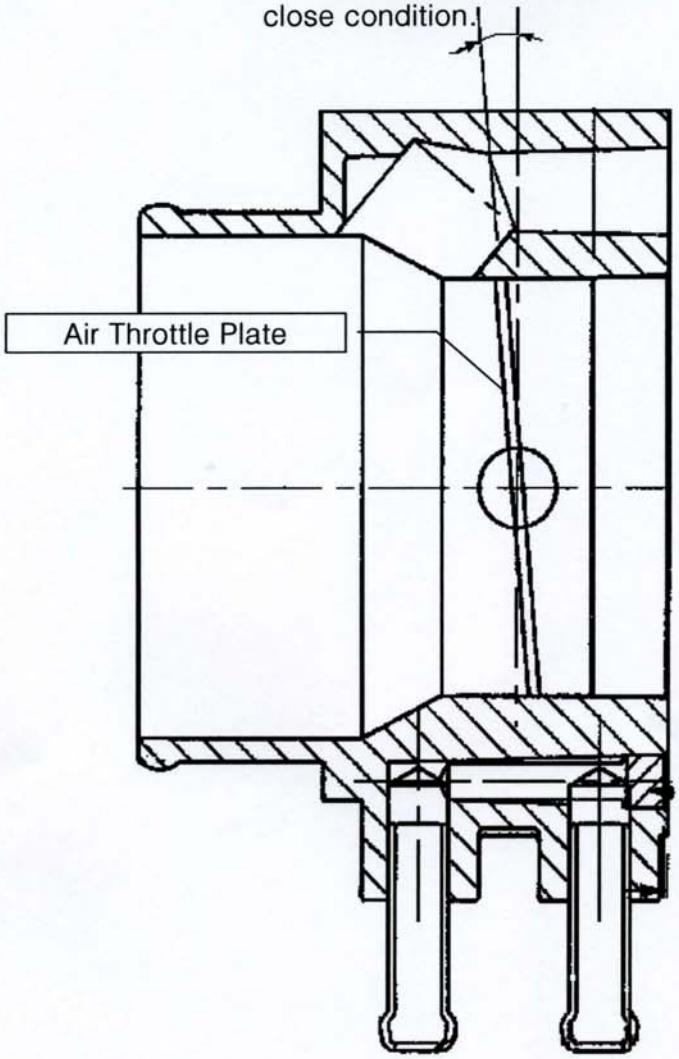
3. Throttle body drawing



07MY Hyundai Elantra FMVSS 124

1. Air throttle plate position

The air throttle plate position is 5° at the close condition.

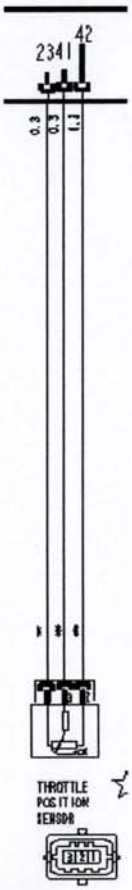


2. Idle rpm :660±100 [RPM at P or N range after engine warm up]
3. Ignition timing : 7°±10°[BTDC @ IDLE]
4. HMC ask you using special scan tool for HMC vehicle (HI-SCAN o HI-DS) ,Idle status will be seen on the scan tool.

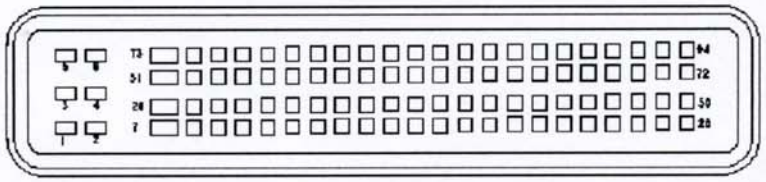
ATTACHMENT 2

07MY Hyundai Elantra FMVSS 124

1. THROTTLE POSITION SENSOR CONNECTOR PIN ARRANGEMENT

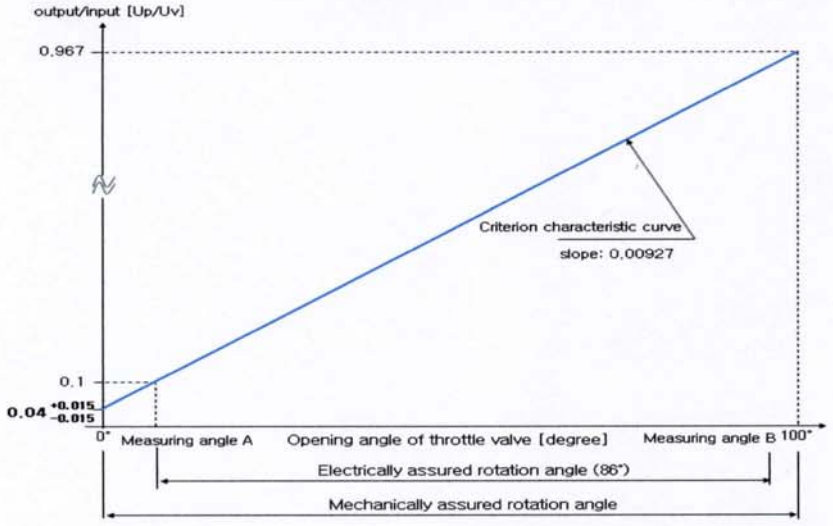


23(1); TPS SUPPLY(5V)
41(3); THROTTLE POSITION SENSOR SIGNAL
42(2); TPS GROUND



PIN ARRANGEMENT OF THE ECM

2. THROTTLE POSITION SENSOR OUTPUT CHARACTERISTIC CURVE

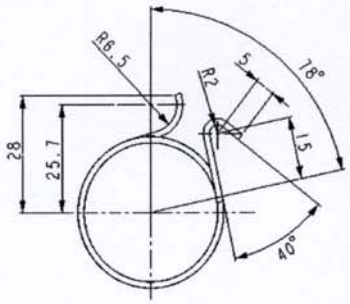


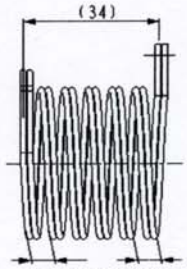
ATTACHMENT 3

07MY Hyundai Elantra FMVSS 124 acc throttle body spring

1. RETURN SPRING DRAWING (2 PICES ON A THROTTLE BODY)

(1) Spring #1

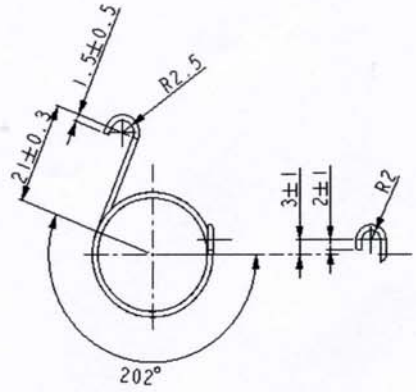


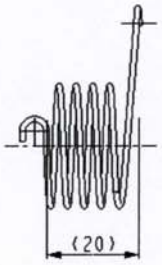


양단을 정방하게 제작할 것.

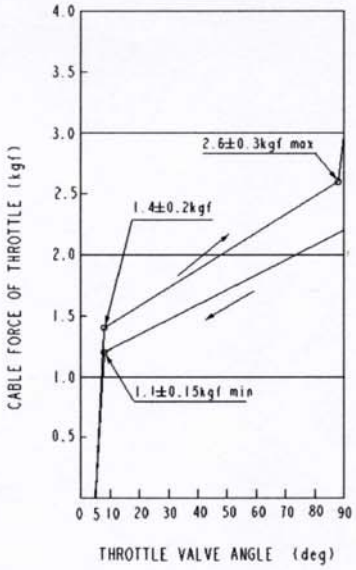
1개의 SPRING에 같은 사양의 SPRING을 회전시켜 병렬로 단면을 이룰 것.

(2) Spring #2

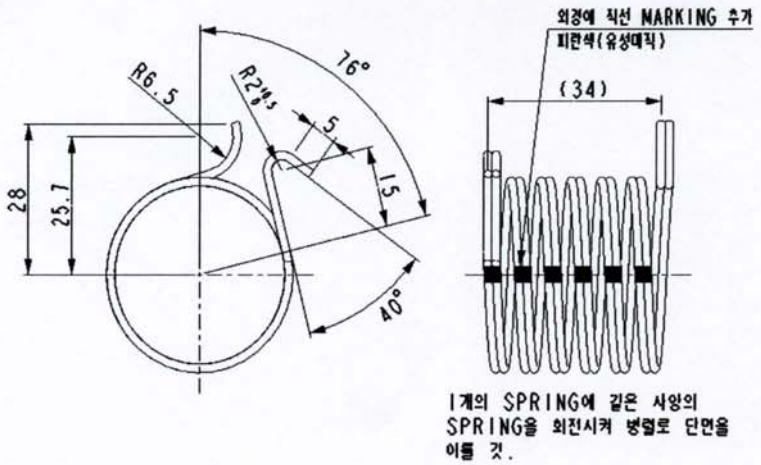




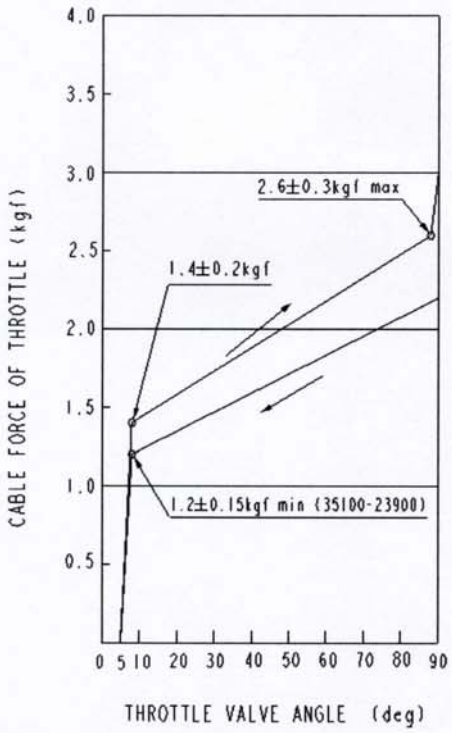
2. SPRING FORCE OF THROTTLE LEVER OPERATION



1. RETURN SPRING DRAWING (2 PICES ON A THROTTLE BODY)



2. SPRING FORCE OF THROTTLE LEVER OPERATION



ATTACHMENT 4