Impreza P1 1999-2000

SUBARU

Exit

SUBARU IMPREZA P1 2000 MY.

TRAINING NOTES.

INTRODUCTION

UK-SPECIFICATION SUBARU IMPREZA P1 TURBO, AS DEVELOPED BY SUBARU (UK) LTD, PRODRIVE LTD, FUJI HEAVY INDUSTRIES LTD AND SUBARU TECNICA INTERNATIONAL (STI) INCORPORATED OF JAPAN.

- SUBARU IMPREZA P1 carries a full SUBARU (UK) LTD 60,000 mile, three-year warranty, One-year paint warranty and a six-year anti-corrosion warranty.
- Meets all European whole vehicle type approval noise and emission standards.
- Initial production run of 1,000 vehicles.
- Full 110 plus dealer parts and service support.

Two door, "Sonic blue"mica paint, ABS four channel type, twin Airbags, AWD centre differential with viscous coupling.

TECHNICAL SPECIFICATION

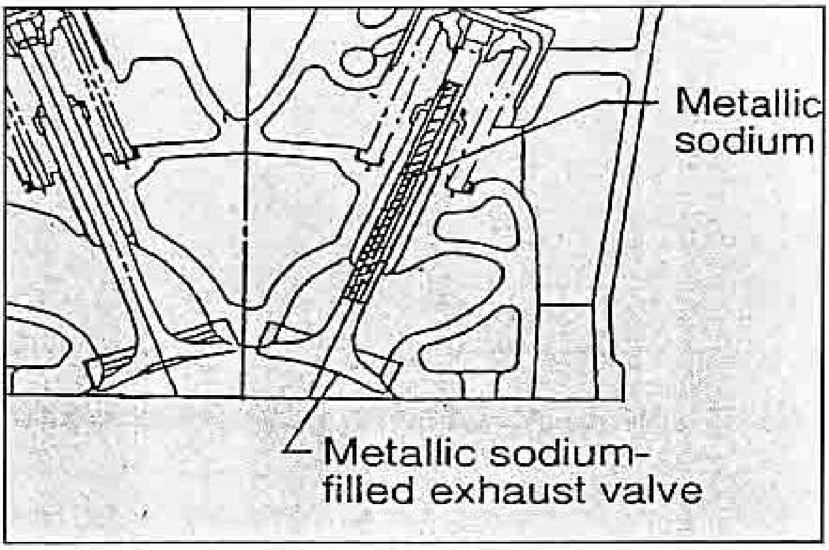
ENGINE

HORIZONTALLY OPPOSED FOUR CYLINDER LIQUID COOLED
BELT DRIVEN FOUR OHC FOUR VALVES PER CYLINDER

BORE	92mm (3.62ins)	
STROKE	75mm (2.95ins)	
ENGINE DISPLACEMENT	1,994cc (121.67cubic ins)	
COMPRESSION RATIO	8:1	
COMPRESSION PRESSURE AT 200/300rpm CRANKING SPEED WIDE OPEN THROTTLE	882 to 1,078 KPA (9 to 11 Kg/cm²) (128 to 156 psi)	
COMPRESSION LIMIT, MINIMUM	128 psi	
IDLE SPEED	700 to 800 rpm (NO LOAD) 750 to 850 rpm (AC ON)	
FIRING ORDER	1 – 3 – 2 – 4	
IGNITION TIMING	2° to 22° BTDC AT 750 RPM	
VALVE CLEARANCE COLD	INLET:	0.18 to 0.22mm (0.0071 to 0.0087ins)
	EXHAUST:	0.23 to 0.27mm (0.009 to 0.0106ins)

PLEASE NOTE! EXHAUST VALVE STEM CONTAINS METALIC SODIUM.

SEE NEXT PAGE FOR HANDLING / DISPOSAL METHODS.



Precautions Regarding Handling of Metallic Sodium-Filled Exhaust Valve on P1.

Metallic Sodium is extremely alkaline and may produce severe chemical reactions. Full consideration must therefore be given to the handling and disposal of damaged or defective valves, as metallic sodium may cause blindness if contact with the eyes occur. Skin contact may result in burns, please use rubber gloves at all times for your own safety.

In the event of valve stem damage and possible leakage, prepare a receptacle with at least (2 gallons of water) place in a well-ventilated area away from all sources of ignition i.e., naked lights or flames. With the aid of rubber gloves and pincers place damaged valve into the water, retire from the area for at least 5 hours. Whilst the reaction is taking place between the Metallic Sodium and the water Hydrogen gas, is produced. This gas is highly explosive and all necessary precautions must be observed at all times. Dispose of valve as normal metallic scrap, the reaction liquid in accordance with local council by-laws.

Undamaged valves must not be incinerated or broken open, please check with your local authority for correct disposal methods.

VALVE TIMING:	INLET	OPENING	9° BTDC	
		CLOSING	53°ABDC	
	EXHAUST	OPENING	58°BBDC	
		CLOSING	10°ATDC	
ENGINE MAXIMUM OUTPUT AT 6,500 RPM USING 100 RON FUEL		206 KW 280 PS DIN 276 SAE BHP		
ENGINE MAXIMUM TORQUE AT 4,000 RPM		353 Nm 36 Kg-m 259 ft –lb		
VEHICLE PERFORMANCE		TOP SPEED	150 MPH	UK ONLY
		0-60MPH	4.8 SECS	
		0-100 MPH SPRINT	12.27SECS	
		STANDING QUARTER MILE	13.49SECS	
		50-70MPH FITH GEAR	6.9SECS	
FUEL CONSUMPTION		URBAN	19MPG	
		EXTRA URBAN	30.4MPG	
		URBAN AND COMBINED CYCLE	25MPG	

VEHICLE SECURITY: FULL THATCHAM GRADE ONE ALARM AND IMMOBILIZER SIGMA M30.

PLEASE NOTE! NO FACTORY ORIGINAL IMMOBILIZER INSTALLED ON P1.

STEERING RACK RATIO 15:1
TUNED TO PRODRIV'S SUSPENSION MODIFICATIONS.

Gear ratios

Gear	Internal gearbox ratios (ratios of engine to gearbox output shaft revolutions)	Final drive ratio(s) (ratio of gearbox output shaft to driven wheel revolutions)	Total gear ratios
1	3,166	4,444	14,070
2	1,882	4,444	8,364
3	1,296	4,444	5,759
4	0,972	4,444	4,320
5	0,738	4,444	3,280
Reverse	3,333	4,444	14,812

NOTE:
STD: Standard I.D.: Inner diameter O.D.: Outer diameter OS: Oversize US: Undersize

Belt tension adjuster	Protrusion of adjuster rod			5.2 — 6.2 mm (0.205 — 0.244 in)
Belt tensioner	Spacer O.D.			17.955 — 17.975 mm (0.7069 — 0.7077 in)
	Tensioner bush I.D.			18.0 — 18.08 mm (0.7087 — 0.7118 in)
	Clearance between spacer and bush		STD	0.025 — 0.125 mm (0.0010 — 0.0049 in)
			Limit	0.175 mm (0.0069 in)
	Side clearance of spacer		STD	0.2 — 0.55 mm (0.0079 — 0.0217 in)
			Limit	0.81 mm (0.0319 in)
Camshaft	Bend limit			0.20 mm (0.0079 in)
	Thrust clearance		STD	0.037 — 0.072 mm (0.0015 — 0.0028 in)
			Limit	0.10 mm (0.0039 in)
	Cam lobe height	Intake	STD	45.25 — 45.35 mm (1.7815 — 1.7854 in)
			Limit	45.15 mm (1.7776 in)
		Exhaust	STD	45.60 — 45.70 mm (1.7953 — 1.7992 in)
			Limit	45.50 mm (1.7913 in)
	Journal O.D.	STD	Front	37.946 — 37.963 mm (1.4939 — 1.4946 in)
			Center rear	29.946 — 29.963 mm (1.1790 — 1.1796 in)
	Oil clearance		STD	0.037 — 0.072 mm (0.0015 — 0.0028 in)
			Limit	0.10 mm (0.0039 in)
Cylinder head	Surface warpage limit			0.05 mm (0.0020 in)
	Surface grinding limit			0.3 mm (0.012 in)
	Standard height			127.5 mm (5.02 in)
Valve seat	Refacing angle			90°
	Contacting width	Intake	STD	1.0 mm (0.039 in)
			Limit	1.7 mm (0.067 in)
		Exhaust	STD	1.4 mm (0.055 in)
			Limit	2.1 mm (0.083 in)
Valve guide	Inner diameter			6.000 — 6.012 mm (0.2362 — 0.2367 in)
	Protrusion above head			12.0 — 12.4 mm (0.472 — 0.488 in)
Valve	Head edge thickness	Intake	STD	1.2 mm (0.047 in)
			Limit	0.8 mm (0.031 in)
		Exhaust	STD	1.5 mm (0.059 in)
			Limit	0.8 mm (0.031 in)
	Stem diameter		Intake	5.955 — 5.970 mm (0.2344 — 0.2350 in)
			Exhaust	5.945 — 5.960 mm (0.2340 — 0.2346 in)
	Stem oil clearance	STD	Intake	0.030 — 0.057 mm (0.0012 — 0.0022 in)
			Exhaust	0.040 — 0.067 mm (0.0016 — 0.0026 in)
		Limit	—	0.15 mm (0.0059 in)
	Overall length		Intake	104.4 mm (4.110 in)
			Exhaust	104.7 mm (4.122 in)
Valve spring	Free length			43.89 mm (1.7279 in)
	Squareness			2.5°, 2.0 mm (0.079 in)
	Tension/spring height			221±16 N (22.5±1.6 kg, 49.6±3.5 lb)/36 mm (1.417 in) 511±26 N (52.1±2.7 kg, 114.9±6.0 lb)/26.6 mm (1.047 in)

Crankshaft	Bend limit			0.035 mm (0.0014 in)
	Crank pin and crank journal	Out-of-roundness		0.020 mm (0.0008 in) or less
		Grinding limit		0.25 mm (0.0098 in)
	Crank pin outer diameter		STD	51.984 — 52.000 mm (2.0466 — 2.0472 in)
			0.03 mm (0.0012 in) US	51.954 — 51.970 mm (2.0454 — 2.0461 in)
			0.05 mm (0.0020 in) US	51.934 — 51.950 mm (2.0446 — 2.0453 in)
			0.25 mm (0.0098 in) US	51.734 — 51.750 mm (2.0368 — 2.0374 in)
	Crank journal outer diameter	#1, #3	STD	59.992 — 60.008 mm (2.3619 — 2.3625 in)
			0.03 mm (0.0012 in) US	59.962 — 59.978 mm (2.3607 — 2.3613 in)
			0.05 mm (0.0020 in) US	59.942 — 59.958 mm (2.3599 — 2.3605 in)
			0.25 mm (0.0098 in) US	59.742 — 59.758 mm (2.3520 — 2.3527 in)
		#2, #4, #5	STD	59.992 — 60.008 mm (2.3619 — 2.3625 in)
			0.03 mm (0.0012 in) US	59.962 — 59.978 mm (2.3607 — 2.3613 in)
			0.05 mm (0.0020 in) US	59.942 — 59.958 mm (2.3599 — 2.3605 in)
			0.25 mm (0.0098 in) US	59.742 — 59.758 mm (2.3520 — 2.3527 in)
	Thrust clearance		STD	0.030 — 0.115 mm (0.0012 — 0.0045 in)
			Limit	0.25 mm (0.0098 in)
	Oil clearance (center, #3)		STD	0.010 — 0.032 mm (0.0004 — 0.0013 in)
			Limit	0.040 mm (0.0016 in)
Crankshaft bearing	Crankshaft bearing thickness	#1, #5	STD	1.998 — 2.011 mm (0.0787 — 0.0792 in)
			0.03 mm (0.0012 in) US	2.017 — 2.020 mm (0.0794 — 0.0795 in)
			0.05 mm (0.0020 in) US	2.027 — 2.030 mm (0.0798 — 0.0799 in)
			0.25 mm (0.0098 in) US	2.127 — 2.130 mm (0.0837 — 0.0839 in)
		#2, #4, #3	STD	2.000 — 2.013 mm (0.0787 — 0.0793 in)
			0.03 mm (0.0012 in) US	2.019 — 2.022 mm (0.0795 — 0.0796 in)
			0.05 mm (0.0020 in) US	2.029 — 2.032 mm (0.0799 — 0.0800 in)
			0.25 mm (0.0098 in) US	2.129 — 2.132 mm (0.0838 — 0.0839 in)

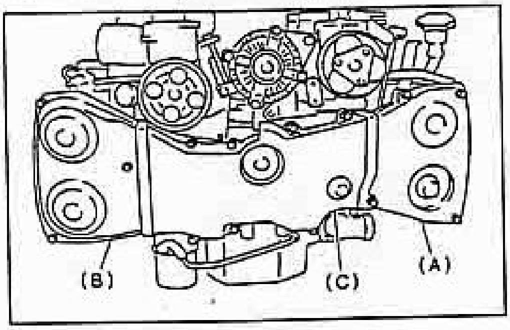
Cylinder block	Surface warpage limit (mating with cylinder head)			0.05 mm (0.0020 in)
	Surface grinding limit			0.1 mm (0.004 in)
	Cylinder bore	STD	A	92.005 — 92.015 mm (3.6222 — 3.6226 in)
			B	91.995 — 92.005 mm (3.6218 — 3.6222 in)
	Taper		STD	0.015 mm (0.0006 in)
			Limit	0.050 mm (0.0020 in)
	Out-of-roundness		STD	0.010 mm (0.0004 in)
			Limit	0.050 mm (0.0020 in)
	Piston clearance		STD	0.010 — 0.030 mm (0.0004 — 0.0012 in)
			Limit	0.050 mm (0.0020 in)
	Enlarging (boring) limit			0.5 mm (0.020 in)
Piston	Outer diameter	STD	A	91.985 — 91.995 mm (3.6214 — 3.6218 in)
			B	91.975 — 91.985 mm (3.6211 — 3.6214 in)
		0.25 mm (0.0098 in) OS		92.225 — 92.235 mm (3.6309 — 3.6313 in)
		0.50 mm (0.0197 in) OS		92.475 — 92.485 mm (3.6407 — 3.6411 in)
Piston pin	Standard clearance between piston pin and hole in piston		STD	0.004 — 0.01 mm (0.0002 — 0.0004 in)
			Limit	0.020 mm (0.0008 in)
	Degree of fit			Piston pin must be fitted into position with thumb at 20°C (68°F).
Piston ring	Piston ring gap	Top ring	STD	0.20 — 0.26 mm (0.0079 — 0.0102 in)
			Limit	0.9 mm (0.035 in)
		Second ring	STD	0.20 — 0.50 mm (0.0079 — 0.0197 in)
			Limit	1.0 mm (0.039 in)
		Oil ring	STD	0.20 — 0.70 mm (0.0079 — 0.0276 in)
			Limit	1.5 mm (0.059 in)
	Clearance between piston ring and piston ring groove	Top ring	STD	0.040 — 0.080 mm (0.0016 — 0.0031 in)
			Limit	0.15 mm (0.0059 in)
		Second ring	STD	0.030 — 0.070 mm (0.0012 — 0.0028 in)
			Limit	0.15 mm (0.0059 in)
Connecting rod	Bend twist per 100 mm (3.94 in) in length		Limit	0.10 mm (0.0039 in)
	Side clearance		STD	0.070 — 0.330 mm (0.0028 — 0.0130 in)
			Limit	0.4 mm (0.016 in)
Connecting rod bearing	Oil clearance		STD	0.020 — 0.046 mm (0.0008 — 0.0018 in)
			Limit	0.06 mm (0.0024 in)
	Thickness at center portion		STD	1.486 — 1.498 mm (0.0585 — 0.0590 in)
			0.03 mm (0.0012 in) US	1.496 — 1.509 mm (0.0589 — 0.0594 in)
			0.05 mm (0.0020 in) US	1.506 — 1.519 mm (0.0593 — 0.0598 in)
			0.25 mm (0.0098 in) US	1.606 — 1.619 mm (0.0632 — 0.0637 in)
Connecting rod bushing	Clearance between piston pin and bushing		STD	0 — 0.022 mm (0 — 0.0009 in)
			Limit	0.030 mm (0.0012 in)

INSTALLATION

CRANKSHAFT PULLEY AND BELT COVER

1) Install front belt cover (C).

Tightening torque (All bolts for belt cover):
4.9±0.5 N·m (0.5±0.05 kg-m, 3.6±0.4 ft-lb)

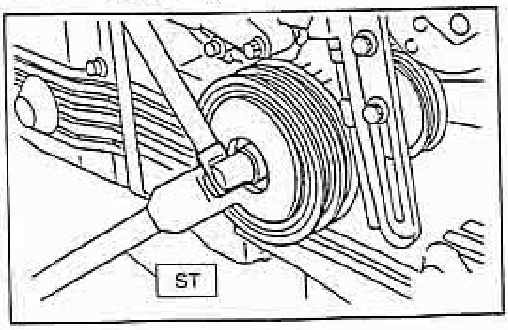


2) Install right-hand belt cover (B).
3) Install left-hand belt cover (A).
4) Install crankshaft pulley.
5) Tighten pulley bolt by using ST.

ST 499977300 CRANKSHAFT PULLEY WRENCH
ST 499977100 CRANKSHAFT PULLY WRENCH

(1) Clean the crankshaft pulley thread using an air gun.
(2) Apply engine oil to the crankshaft pulley bolt seat and thread.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kg-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts.

Tightening torque:
$127^{+10}/_{-5}$ N·m ($13^{+1.0}/_{-0.5}$ kg-m, $94.0^{+7.2}/_{-3.6}$ ft-lb)



6) Confirm that the tightening angle of the crankshaft pulley bolt is 45 degrees or more. If not, conduct the following procedures.

CAUTION:
If the tightening angle of crankshaft pulley bolt is less than 45 degrees, the bolt should be damaged. In this case, the bolt must be replaced.

(1) Replace the crankshaft pulley bolts and clean them.

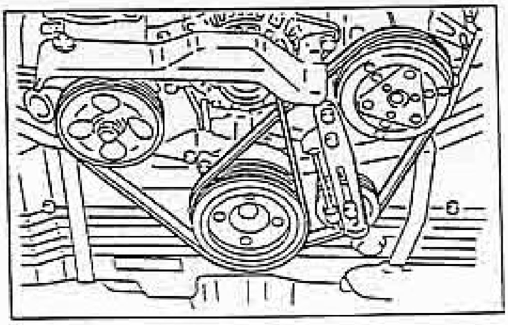
Crankshaft pulley bolt:
12369AA011

(2) Clean the crankshaft thread using an air gun.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kg-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts keeping them in an angle between 45 degrees and 60 degrees.

CAUTION:
Conduct the tightening procedures by confirming the turning angle of the crankshaft pulley bolt referring to the gauge indicated on the belt cover.

7) Install V-belt, air conditioning compressor drive belt tensioner and V-belt cover. <Ref. to 1-5 [01A0].☆6>

CAUTION:
After installing V-belt, check and adjust V-belt tension.



7. CYLINDER BLOCK

1. CYLINDER BLOCK

1) Check for cracks and damage visually. Especially, inspect important parts by means of red lead check.
2) Check the oil passages for clogging.
3) Inspect crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

Warping limit:
0.05 mm (0.0020 in)

Grinding limit:
0.1 mm (0.004 in)

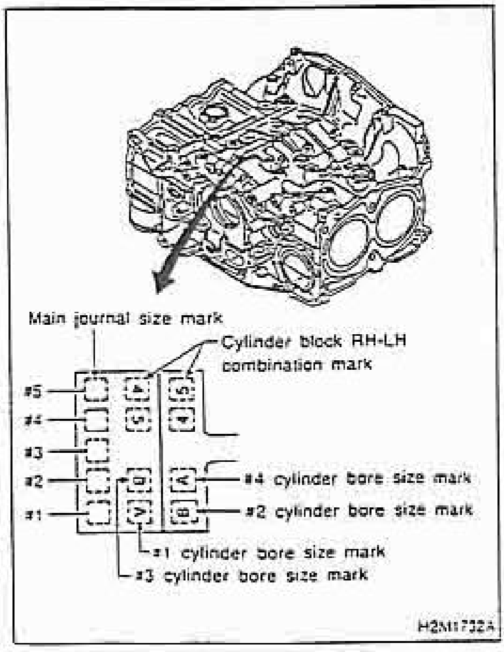
Standard height of cylinder block:
201.0 mm (7.91 in)

8. CYLINDER AND PISTON

1) The cylinder bore size is stamped on the cylinder block's front upper surface.

NOTE:
Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as a guide line in selecting a standard piston.

Standard diameter:
A: 92.005 — 92.015 mm (3.6222 — 3.6226 in)
B: 91.995 — 92.005 mm (3.6218 — 3.6222 in)

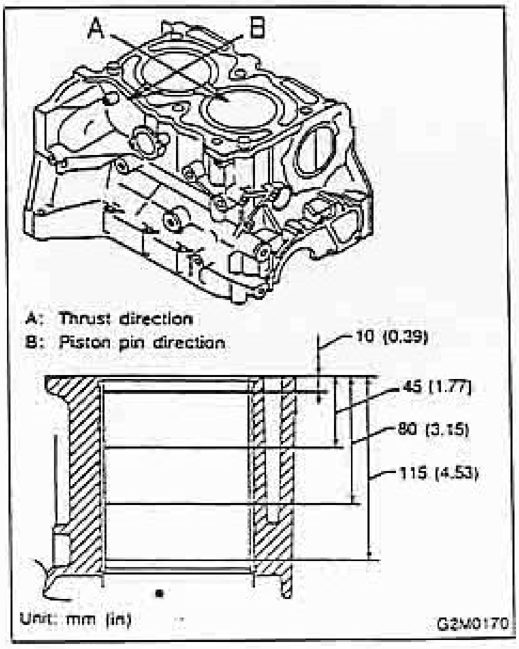


2) How to measure the inner diameter of each cylinder
Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in figure, using a cylinder bore gauge.

CAUTION:
Measurement should be performed at a temperature 20°C (68°F).

Taper:
Standard
0.015 mm (0.0006 in)
Limit
0.050 mm (0.0020 in)

Out-of-roundness:
Standard
0.010 mm (0.0004 in)
Limit
0.050 mm (0.0020 in)



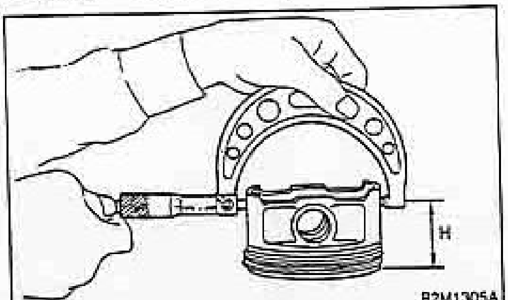
3) When piston is to be replaced due to general or cylinder wear, determine a suitable sized piston by measuring the piston clearance.

4) How to measure the outer diameter of each piston
Measure the outer diameter of each piston at the height shown in figure. (Thrust direction)

CAUTION:
Measurement should be performed at a temperature of 20°C (68°F).

Piston grade point H:
40.0mm (1.575 in)

Piston outer diameter:
Standard
A: 91.985 — 91.995 mm (3.6214 — 3.6218 in)
B: 91.975 — 91.985 mm (3.6211 — 3.6214 in)
0.25 mm (0.0098 in) oversize
92.225 — 92.235 mm (3.6309 — 3.6313 in)
0.50 mm (0.0197 in) oversize
92.475 — 92.485 mm (3.6407 — 3.6411 in)



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5) Calculate the clearance between cylinder and piston.

CAUTION:
Measurement should be performed at a temperature of 20°C (68°F).

Cylinder to piston clearance at 20°C (68°F):
Standard
0.010 — 0.030 mm (0.0004 — 0.0012 in)
Limit
0.050 mm (0.0020 in)

6) Boring and honing
(1) If the value of taper, out-of-roundness, or cylinder-to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

CAUTION:
When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.

(2) If the cylinder inner diameter exceeds the limit after boring and honing, replace the crankcase.

CAUTION:
Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

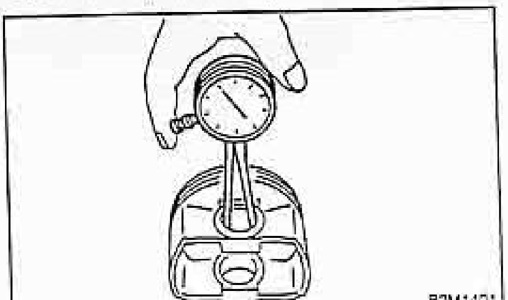
Limit of cylinder enlarging (boring):
0.5 mm (0.020 in)

9. PISTON AND PISTON PIN

1) Check pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
2) Measure the piston-to-cylinder clearance at each cylinder.

If any of the clearances is not to specification, replace the piston or bore the cylinder to use an oversize piston.
3) Make sure that piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if defective.

Standard clearance between piston pin and hole in piston:
Standard
0.004 — 0.010 mm (0.0002 — 0.0004 in)
Limit
0.020 mm (0.0008 in)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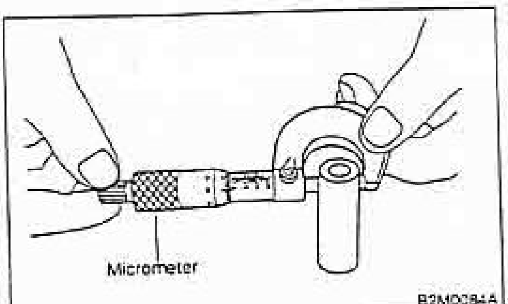

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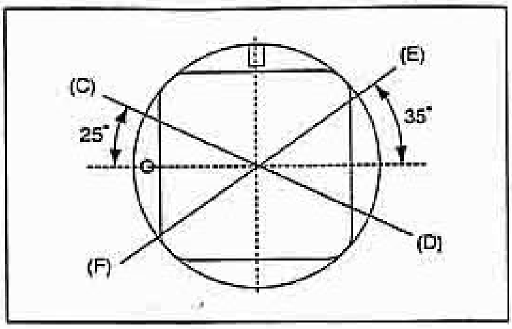
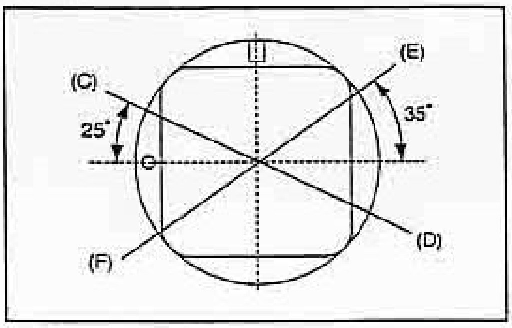
(4) Position the upper rail gap at (C) or (D) in the figure.



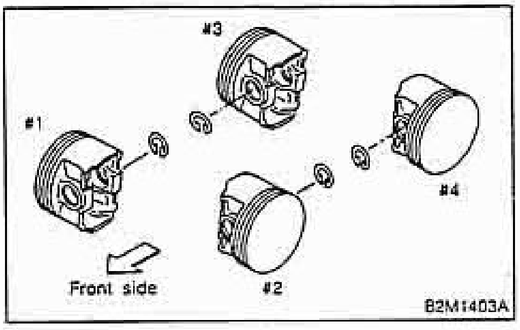
(5) Position the expander gap at 180° of the reverse side for the upper rail gap.
(6) Position the lower rail gap at (E) or (F) in the figure.

CAUTION:
- **Ensure ring gaps do not face the same direction.**
- **Ensure ring gaps are not within the piston skirt area.**

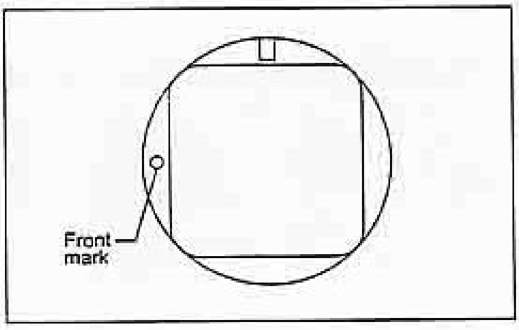


5) Install circlip.
Install circlips in piston holes located opposite service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

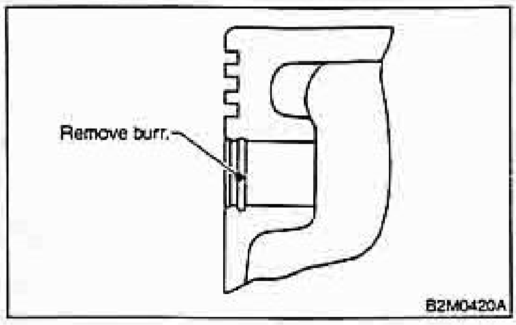
CAUTION:
Use new circlips.



CAUTION:
Piston front mark faces towards the front of the engine.



4) Check circlip installation groove on the piston for burr. If necessary, remove burr from the groove so that piston pin can lightly move.



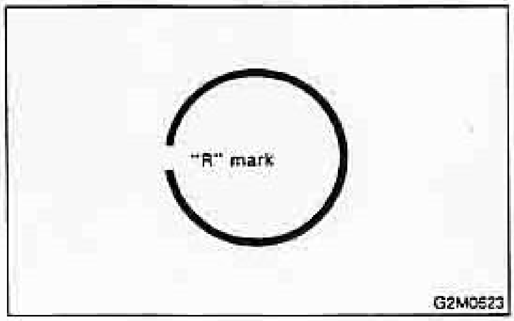
5) Check piston pin circlip for distortion, cracks and wear.

10.PISTON RING

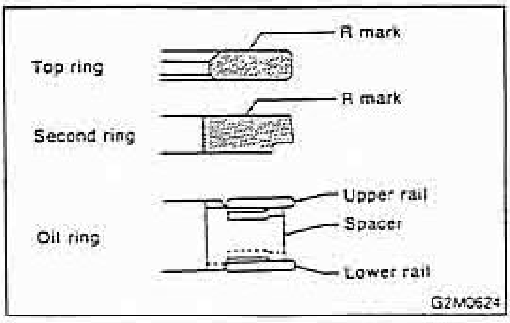
1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

CAUTION:

- **"R" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.**

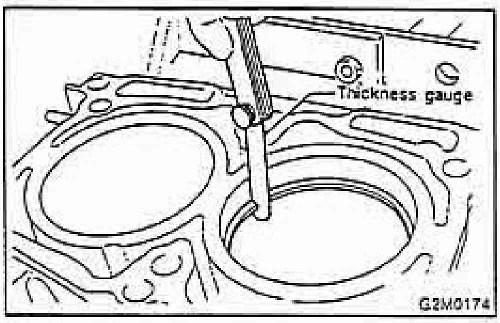


- **The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful to assemble correctly.**



2) Squarely place piston ring and oil ring in cylinder, and measure the piston ring gap with a thickness gauge.

		Unit: mm (in)	
		Standard	Limit
Piston ring gap	Top ring	0.20 — 0.35 (0.0079 — 0.0138)	1.0 (0.039)
	Second ring	0.20 — 0.50 (0.0079 — 0.0197)	1.0 (0.039)
	Oil ring rail	0.20 — 0.70 (0.0079 — 0.0276)	1.5 (0.059)

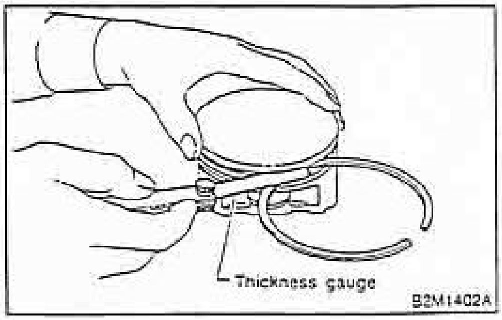


3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

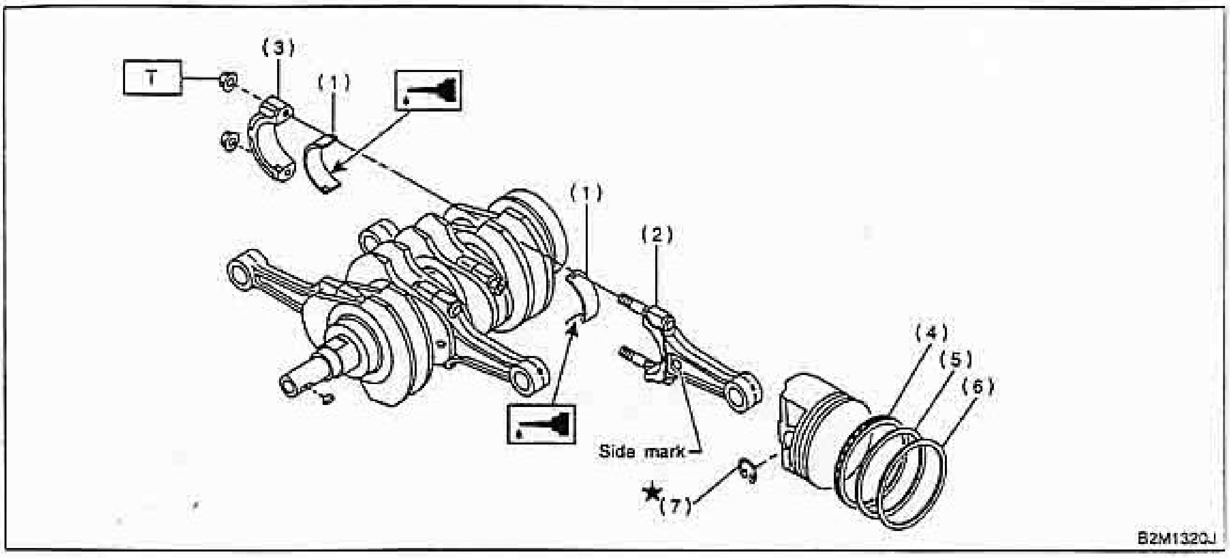
CAUTION:

Before measuring the clearance, clean the piston ring groove and piston ring.

		Unit: mm (in)	
		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.040 — 0.080 (0.0016 — 0.0031)	0.15 (0.0059)
	Second ring	0.030 — 0.070 (0.0012 — 0.0028)	0.15 (0.0059)



CRANKSHAFT AND PISTON



(1) Connecting rod bearing
(2) Connecting rod
(3) Connecting rod cap
(4) Oil ring
(5) Second ring
(6) Top ring
(7) Circlip

Tightening torque: N·m (kg-m, ft-lb)
T: 44.6±1.5 (4.55±0.15, 32.9±1.1)

1) Install connecting rod bearings on connecting rods and connecting rod caps.

CAUTION:
Apply oil to the surfaces of the connecting rod bearings.

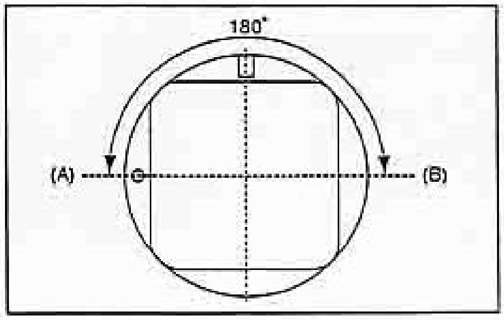
2) Install connecting rod on crankshaft.

CAUTION:
Position each connecting rod with the side marked facing forward.

3) Install connecting rod cap with connecting rod nut.
Ensure the arrow on connecting rod cap faces the front during installation.

CAUTION:
• Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.
• When tightening the connecting rod nuts, apply oil on the threads.

4) Installation of piston rings and oil ring
(1) Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.
(2) Position the top ring gap at (A) or (B) in the figure.



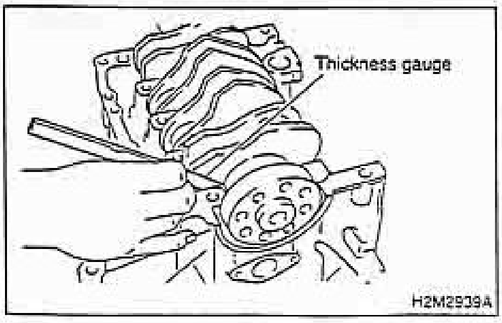
(3) Position the second ring gap at 180° on the reverse side for the top ring gap.

				Unit: mm (in)
		Crank journal diameter		Crank pin diameter
		#1, #3	#2, #4, #5	
Standard	Journal O.D.	59.992 — 60.008 (2.3619 — 2.3625)	59.992 — 60.008 (2.3619 — 2.3625)	51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.011 (0.0787 — 0.0792)	2.000 — 2.013 (0.0787 — 0.0793)	1.486 — 1.498 (0.0585 — 0.0590)
0.03 (0.0012) undersize	Journal O.D.	59.962 — 59.978 (2.3607 — 2.3613)	59.962 — 59.978 (2.3607 — 2.3613)	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	1.496 — 1.509 (0.0589 — 0.0594)
0.05 (0.0020) undersize	Journal O.D.	59.942— 59.958 (2.3599 — 2.3605)	59.942 — 59.958 (2.3599 — 2.3605)	51.934 — 51.950 (2.0446 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	1.506 — 1.519 (0.0593 — 0.0598)
0.25 (0.0098) undersize	Journal O.D.	59.742 — 59.758 (2.3520 — 2.3527)	59.742 — 59.758 (2.3520 — 2.3527)	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.606 — 1.619 (0.0632 — 0.0637)

O.D. ... Outer Diameter

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace bearing.

Crankshaft thrust clearance:
Standard
0.030 — 0.115 mm (0.0012 — 0.0045 in)
Limit
0.25 mm (0.0098 in)



5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.

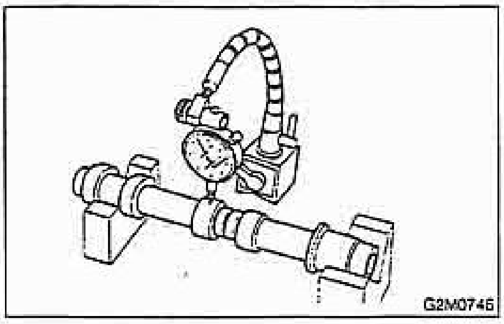
6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

	Unit: mm (in)
Crankshaft oil clearance	
Standard	0.010 — 0.032 (0.0004 — 0.0013)
Limit	0.040 (0.0016)

Camshaft
INSPECTION
CAMSHAFT

1) Measure the bend, and repair or replace if necessary.

Limit:
0.020 mm (0.0008 in)



2) Check journal for damage and wear. Replace if faulty.
3) Measure outside diameter of camshaft journal. If the journal diameter is not as specified, check the oil clearance.

	Camshaft journal	
	Front	Center, rear
Standard	37.946 — 37.963 mm (1.4939 — 1.4946 in)	29.946 — 29.963 mm (1.1790 — 1.1796 in)

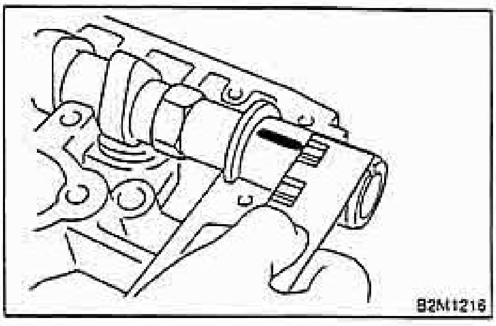
4) Measurement of the camshaft journal oil clearance
(1) Clean the bearing caps and camshaft journals.
(2) Place the camshafts on the cylinder head. (Without installing valve rocker.)
(3) Place plastigauge across each of the camshaft journals.
(4) Install the bearing caps.
<Ref. to 2-3b [W4C1].☆6>

CAUTION:
Do not turn the camshaft.

(5) Remove the bearing caps.
(6) Measure the widest point of the plastigauge on each journal.
If the oil clearance exceeds the limit, replace the camshaft. If necessary, replace the camshaft caps and cylinder head as a set.

Standard oil clearance:
0.037 — 0.072 mm (0.0015 — 0.0028 in)

Limit:
0.10 mm (0.0039 in)



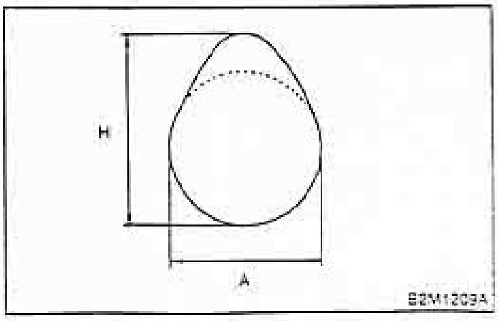
(7) Completely remove the plastigauge.
5) Check cam face condition; remove minor faults by grinding with oil stone. Measure the cam height H; replace if the limit has been exceeded.

Cam height: H

Standard:
Intake:
45.25 — 45.35 mm (1.7815 — 1.7854 in)
Exhaust:
45.60 — 45.70 mm (1.7953 — 1.7992 in)

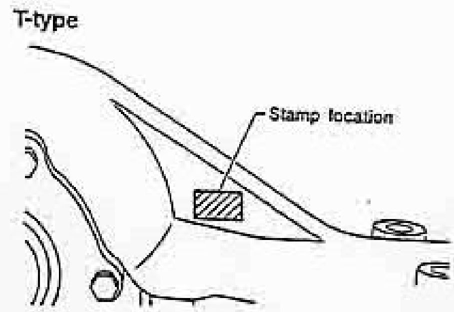
Limit:
Intake:
45.15 mm (1.7776 in)
Exhaust:
45.50 mm (1.7913 in)

Cam base circle diameter A:
37.0 mm (1.457 in)

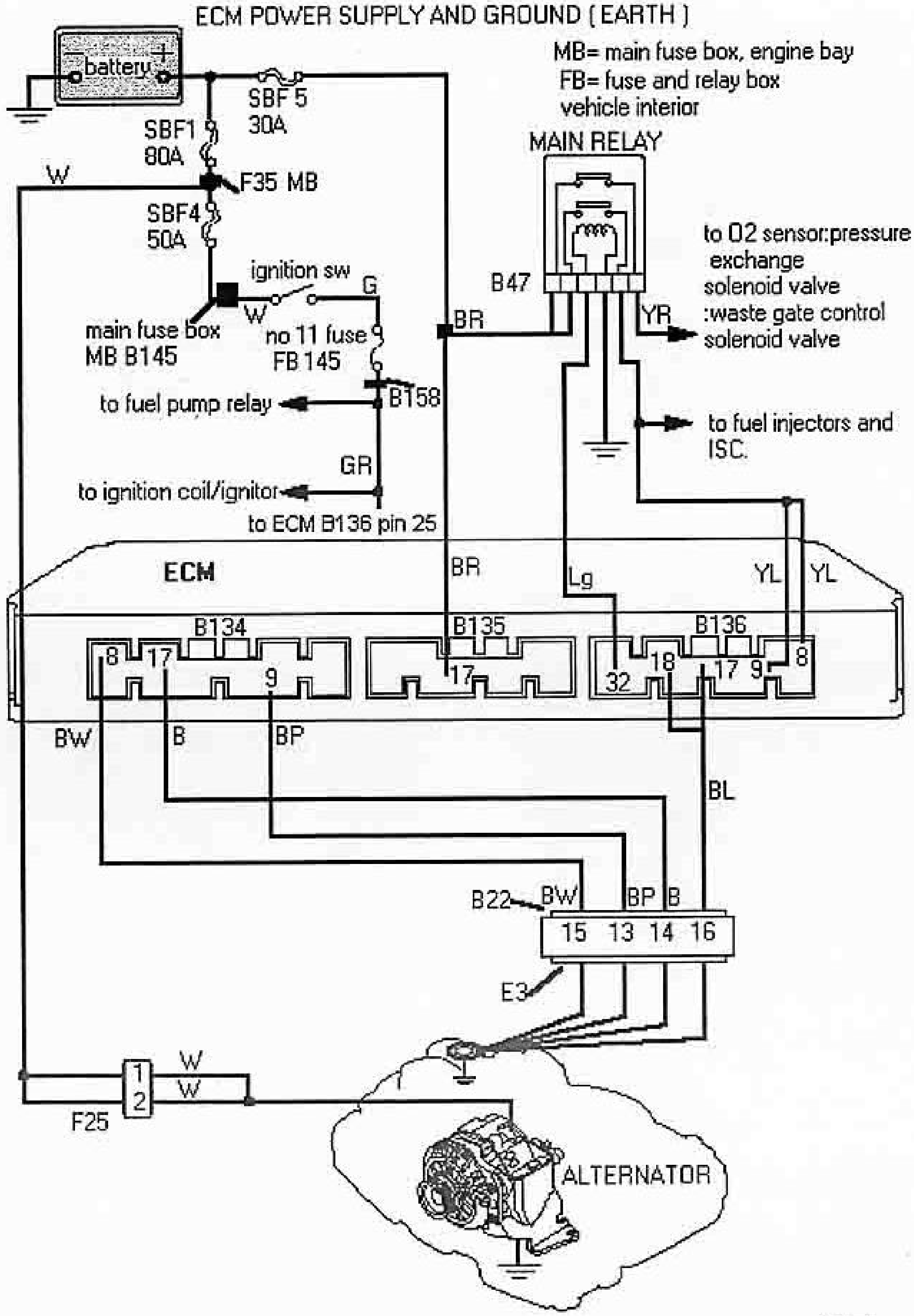


REAR AXLE IDENTIFICATION CODE FOR P1 VISCOUS LIMITED SLIP DIFFERENTIAL

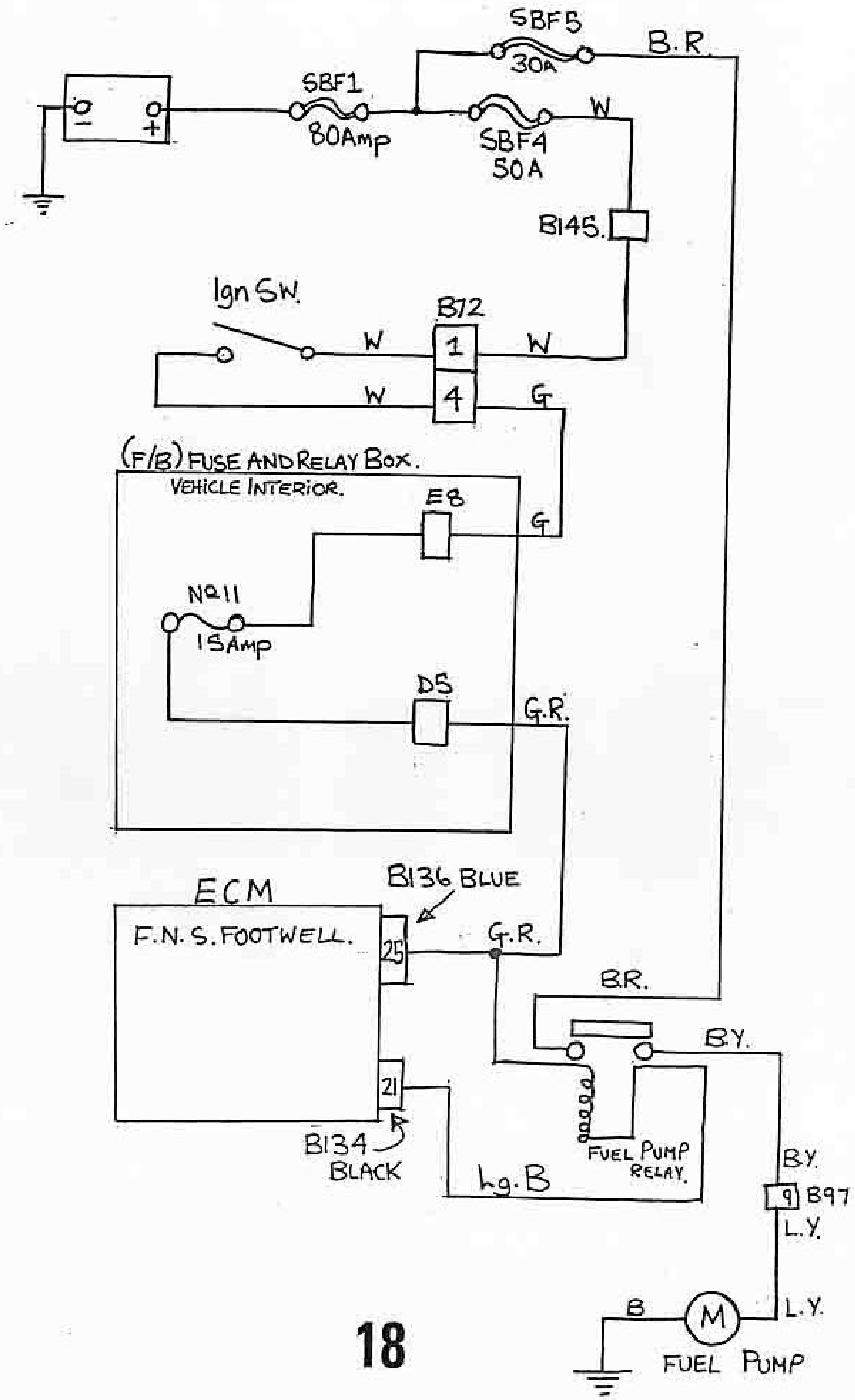
T-type



T-type	2000 cc MT turbo	4.444	C F


ECM POWER SUPPLY AND GROUND (EARTH)
MB= main fuse box, engine bay
FB= fuse and relay box
vehicle interior
MAIN RELAY
battery
SBF 5
30A
SBF1
80A
W
F35 MB
SBF4
50A
ignition sw
G
W
main fuse box
MB B145
no 11 fuse
FB 145
B47
BR
YR
to O2 sensor:pressure
exchange
solenoid valve
:waste gate control
solenoid valve
to fuel pump relay
B158
to fuel injectors and
ISC.
GR
to ignition coil/ignitor
to ECM B136 pin 25
ECM
BR
Lg
YL
YL
B134
B135
B136
8
17
9
17
32
18
17
9
8
BW
B
BP
BL
B22
BW
BP
B
15
13
14
16
E3
W
W
1
2
F25
ALTERNATOR

IGNITION ON POWER INSTIGATION TO ECM



SUBARU IMPREZA P1 2000 MY

No.	Load
MB-1	Headlight washer module Power window and sunroof circuit breaker
MB-3	Engine control module Fuel pump relay Main relay
MB-4	Diode (With rear fog light) Lighting switch
MB-5	Cruise control sub switch Horn switch
MB-6	
MB-7	Hazard switch
MB-8	Horn
MB-9	Headlight LH
MB-10	Headlight RH Combination meter
MB-11	A/C relay holder
MB-12	Parking switch
MB-13	Clock Combination meter Door lock timer Luggage room light Radio Room Light Spot light Trailer connector Trunk room light A/C control module
SBF-7	ABS control module
ALT	Combination meter
ST	Engine control module Starter motor (MT)
FB-1	Headlight leveller LH Headlight leveller RH Sub fan relay-1
FB-2	Parking switch
FB-3	Blower motor relay
FB-4	Front fog light relay
FB-5	ABS control module
FB-6	Stop light switch
FB-7	Rear fog light relay
FB-8	Airbag control module
FB-9	Airbag control module
FB-10	Engine control module Fuel pump relay Ignition coil and ingnitor
FB-11	Blower motor relay Mode control panel Rear defogger switch A/C control module Pressure switch
FB-12	A/C relay Main fan relay – 1 Main fan relay – 2 Sub fan relay – 2 Thermal protector Compressor

No.	Load
FB-13	Back-up light switch (MT) Check connector Combination meter Headlight levelling switch Hazard switch Headlight washer switch Power window and sunroof relay
FB-14	Rear defogger switch
FB-15	Rear defogger Rear defogger switch
FB-16	Lighting switch
FB-17	Parking switch
FB-19	Bright switch Front fog light relay Front fog light switch Illumination control module Illumination light License plate light Rear fog light relay Rear fog light switch A/C control module
FB-20	Cigarette lighter Remote control reaview mirror switch
FB-21	Clock Radio
FB-22	Front washer motor Front wiper motor Front wiper & washer switch Rear washer motor Rear wiper relay Rear wiper motor
FB-24	Tail light LH Tail light RH Trailer connector
FB-25	Front clearance light LH Front clearance light RH
FB-26	Combination meter Hazard switch Rear turn signal light LH Side turn signal light LH Trailer connector Turn signal switch
FB-27	Front Turn signal light LH
FB-28	Combination meter Hazard switch Rear turn signal light RH Trailer connector Turn signal switch
FB-29	Front turn signal light RH Side turn signal light RH
FB-30	ABS control module Cruise control main switch Cruise control module

Control Module I/O Signal

Content		Connector No.	Terminal No.	Signal (V) Ignition SW ON (Engine OFF)	Signal (V) Engine ON (Idling)	Note
Crankshaft position sensor	Signal (+)	B136	6	0	±6	Sensor output waveform
	Signal (−)	B136	23	0	0	—
	Shield	B136	30	0	0	—
Camshaft position sensor	Signal (+)	B136	5	0	±6	Sensor output waveform
	Signal (−)	B136	23	0	0	—
	Shield	B136	30	0	0	—
Mass air flow sensor	Signal	B136	1	1	1.0 — 1.7	—
	Shield	B136	30	0	0	—
	GND	B136	31	0	0	—
Throttle position sensor	Signal	B136	20	Fully closed: 0.5±0.3 Fully opened: 4.3±0.3		—
	Power supply	B136	12	5	5	—
	GND	B136	24	0	0	—
Oxygen sensor	Signal	B136	21	0	Rich mixture: 0.7 Lean mixture: 0	
	Shield	B136	30	0	0	—
Engine coolant temperature sensor	Signal	B136	28	0.6 — 1.0	0.6 — 1.0	After warm-up
	GND	B136	24	0	0	—
Intake air temperature sensor		B136	19	2.5 — 2.3	1.4 — 1.6	After warm-up
Vehicle speed sensor		B135	26	0 or 5	0 or 5	"5" and "0" are repeatedly displayed when vehicle is driven.
Starter switch		B135	2	0	0	Cranking: 10 to 14
A/C switch		B135	11	ON: 10 — 13 OFF: 0	ON: 13 — 14 OFF: 0	—
Ignition switch		B136	25	10 — 13	13 — 14	—
Neutral position switch (MT)		B135	29	ON: 5 OFF: 0		Switch is ON when gear is in neutral position.
Test mode connector		B135	22	5	5	When connected: 0
Read memory connector		B135	13	5	5	When connected: 0
Back-up power supply		B135	17	10 — 13	13 — 14	—
Control unit power supply		B136	9 8	10 — 13	13 — 14	—
Ignition control	# 1, # 2	B134	7	0	3.4, max.	—
	# 3, # 4	B134	16	0	3.4, max.	—
Fuel injector	# 1	B134	31	10 — 13	13 — 14	Waveform
	# 2	B134	32	10 — 13	13 — 14	Waveform
	# 3	B134	25	10 — 13	13 — 14	Waveform
	# 4	B134	18	10 — 13	13 — 14	Waveform

Content		Connector No.	Terminal No.	Signal (V)		Note
				Ignition SW ON (Engine OFF)	Engine ON (Idling)	
Idle air control solenoid valve	Signal 1	B134	14	—	1 — 13	Waveform
	Signal 2	B134	5	—	1 — 13	Waveform
	Signal 3	B134	15	—	1 — 13	Waveform
	Signal 4	B134	6	—	1 — 13	Waveform
Fuel pump relay control		B134	21	ON: 0 OFF: 10 — 13	0	—
A/C relay control		B134	22	ON: 0 OFF: 10 — 13	ON: 0 OFF: 10 — 14	—
Radiator fan relay 1 control		B134	4	ON: 0 OFF: 10 — 13	ON: 0 OFF: 10 — 14	—
Radiator fan relay 2 control		B134	13	ON: 0 OFF: 10 — 13	ON: 0 OFF: 10 — 14	—
Self-shutoff control		B136	32	10 — 13	10 — 14	ON WITH ~~ING~~ OFF
Malfunction indicator lamp		B134	28	—	—	Light "ON": 1, max. Light "OFF":10 — 14
Engine speed output		B135	14	—	0 — 13, min.	Waveform
Knock sensor	Signal	B136	26	2.8	2.8	—
	Shield	B136	29	0	0	—
Wastegate control		B134	19	10 — 13	13 — 14	—
Pressure sources switching solenoid valve		B134	26	10 — 13	13 — 14	—
Purge control solenoid valve		B135	7	ON: 0 OFF: 10 — 13	ON: 0 OFF: 10 — 14	—
GND (sensors)		B136	24	0	0	—
GND (injectors)		B134	9	0	0	—
GND (ignition system)		B134	17	0	0	—
GND (power supply)		B134	8	0	0	—
GND (control systems)		B136	18	0	0	—
		B136	21	0	0	—
Select monitor signal		B136	3	—	—	—
			4	—	—	—
Power steering switch		B135	1	ON: 0 OFF: 10 — 13	ON: 0 OFF: 10 — 13	—
MT identification		B135	4	0	0	—
Pressure sensor		B136	7	5	5	—

Diagnostics Chart with Trouble Code

TROUBLE CODE (DTC)

Trouble code	Item	Contents of diagnosis
11	Crankshaft position sensor	• No signal entered from crankshaft position sensor when starter switch is ON. • The harness connector between ECM and crankshaft position sensor is in short or open.
12	Starter switch	• The starter switch signal is abnormal. • The harness connector between ECM and starter switch is in short or open.
13	Camshaft position sensor	• No signal entered from camshaft position sensor, but signal entered from crankshaft position sensor. • The harness connector between ECM and camshaft position sensor is in short or open.
21	Engine coolant temperature sensor	• The engine coolant temperature sensor signal is abnormal. • The harness connector between ECM and engine coolant temperature sensor is in short or open.
22	Knock sensor	• The knock sensor signal is abnormal. • The harness connector between ECM and knock sensor is in short or open.
23	Mass air flow sensor	• The mass air flow sensor signal is abnormal. • The harness connector between ECM and mass air flow sensor is in short or open.
24	Idle air control solenoid valve	• The idle air control solenoid valve is not in function. • The harness connector between ECM and idle air control solenoid valve is in short or open.
31	Throttle position sensor	• The throttle position sensor signal is abnormal. • The throttle position sensor is installed abnormally. • The harness connector between ECM and throttle position sensor is in short or open.
32	Oxygen sensor	• The oxygen sensor is not in function. • The harness connector between ECM and oxygen sensor is in short or open.
33	Vehicle speed signal	• The vehicle speed signal is abnormal. • The harness connector between ECM and vehicle speed sensor is in short or open.
44	Wastegate control solenoid valve	• The wastegate control solenoid valve is not in function. • The harness connector between ECM and wastegate control solenoid valve is in short or open.
45	• Pressure sensor • Pressure sources switching solenoid valve	• The pressure sensor signal is abnormal. • The pressure sources switching solenoid valve is not in function. • The intake manifold pressure is not transmitted to pressure sensor. • The harness connector between ECM and pressure sensor, and pressure sources switching solenoid valve is in short or open.
51	Neutral position switch	• The neutral position switch signal is abnormal. • The harness connector between ECM and neutral position switch is in short or open.
85	Charge system	Charge system is abnormal.

NEW SELECT MONITOR DATA: IGN ON, ENGINE OFF.

ALPHA
ALFA

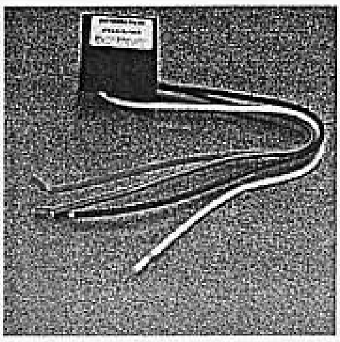
Coolant Temp.	+16 °C
A/F Correction #1	+0.0 %
Engine Speed	25 rpm
Vehicle Speed	0 MPH
Ignition Timing	+10.0 deg
Intake Air Temp.	+19 °C
Front 02 Sensor #1	0.335 V
Battery Voltage	12.2 V
Air Flow Sensor Voltage	1.02 V
Throttle Sensor Voltage	0.50 V
Fuel Injection #1 Pulse	0.51 ms
Knocking Correction	+0.0 deg
Atmosphere Pressure	743 mmHg
Mani. Relative Pressure	-8 mmHg
Primary Control	0.0 %
CPC Valve Duty Ratio	0 %
ISC Valve Step	128 STEP
ALT duty	0 %
AT Vehicle ID Signal	OFF
Test Mode Signal	OFF
Read Memory Signal	OFF
Neutral Position Switch	ON
Idle Switch Signal	ON
Int'cool auto washer SW	OFF
Ignition Switch	ON
P/S Switch	OFF
A/C Switch	OFF
Starter Switch	OFF
Front 02 #1 Rich Signal	OFF
Knocking Signal	OFF
Crankshaft Position Sig.	OFF
Camshaft Position Sig.	OFF
Rear Defogger SW	ON
Blower Fan SW	OFF
Light Switch	OFF
A/C Compressor Signal	OFF
Radiator Fan Relay #1	OFF
Radiator Fan Relay #2	OFF
Fuel Pump Relay	OFF
Int'cool auto wash relay	OFF
Pressure Sources Change	OFF
Torque Control Signal #1	OFF
Torque Control Signal #2	OFF
Torque Permission Signal	OFF

Print	F2	Lock	Clear

SUBARU IMPREZA P1 2000 MY

ECM LOCATION FRONT NEAR SIDE FOOTWELL # 22611AG340

ID TYPE: IB A18-000 D4E 9Z07



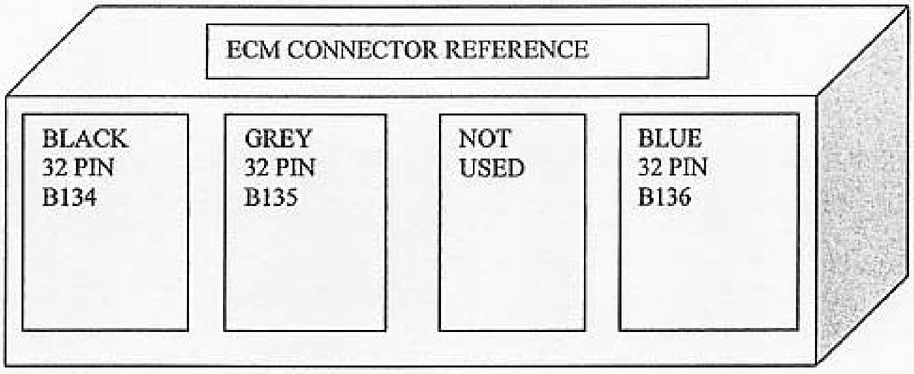
SPEED DELIMITER **SACC 6018**
PRODRIVE EH/E5/001

RED: +12volt

BLUE: SPEED SIGNAL INPUT TO DELIMITER

YELLOW: OUTPUT SIGNAL TO ECM

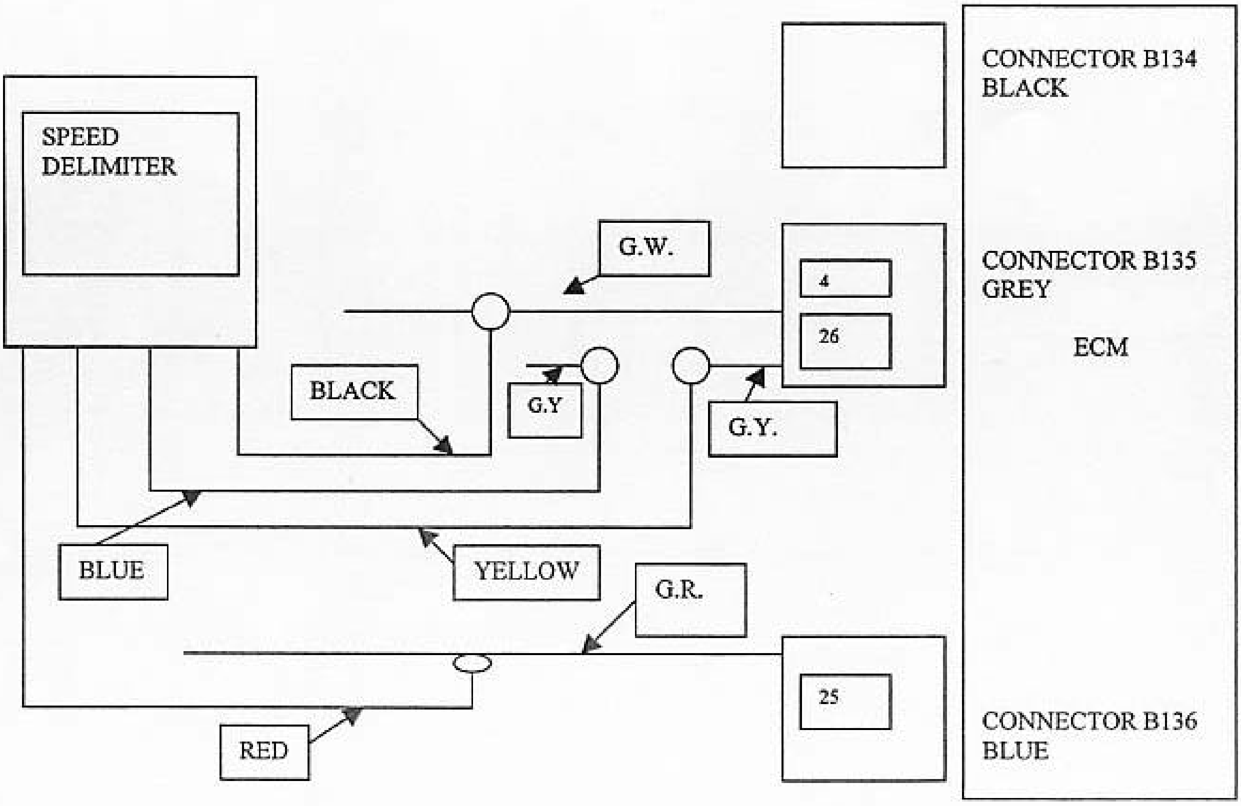
BLACK: NEGATIVE EARTH



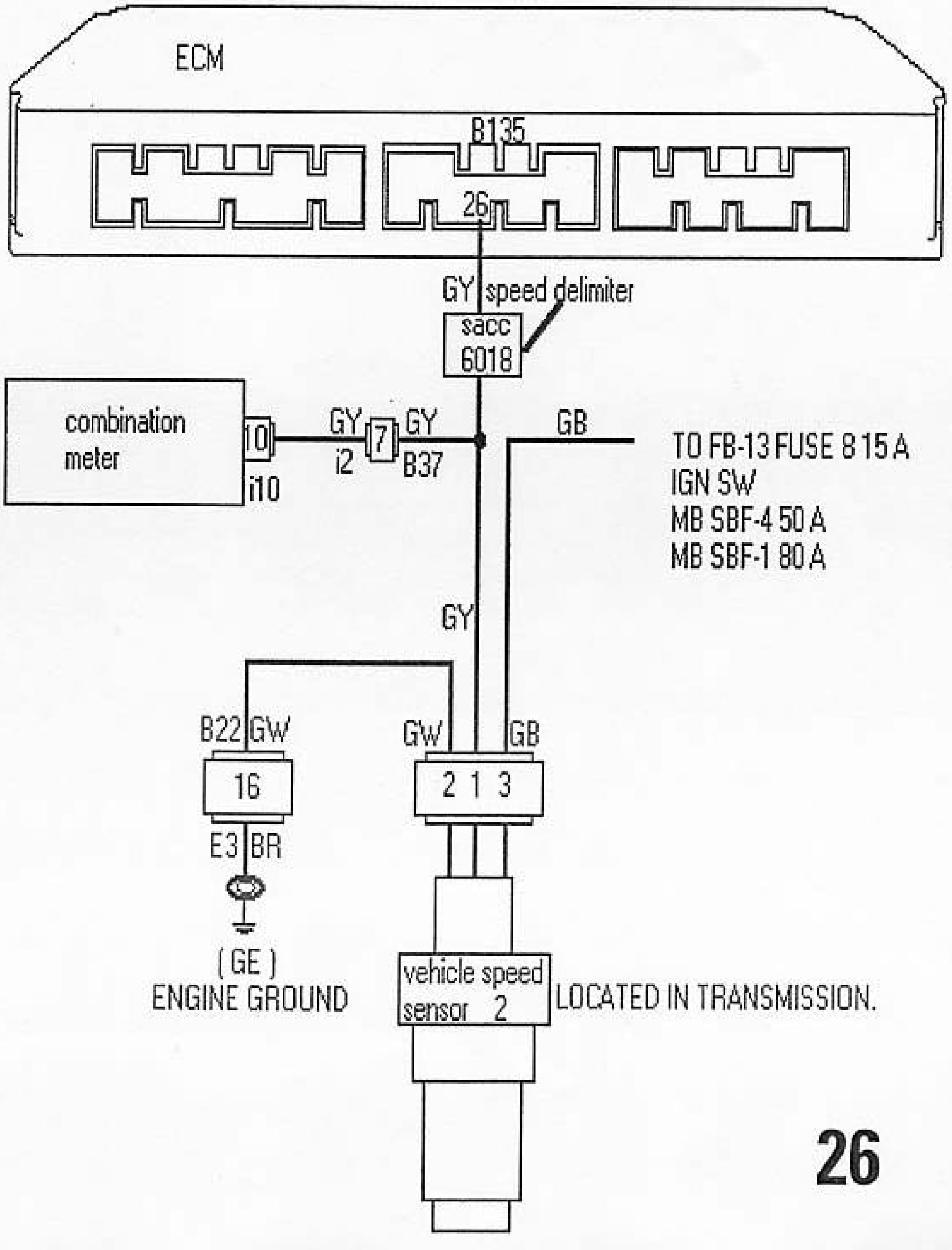
THE OBJECT OF THE SPEED DELIMITER IS TO MAINTAIN AN INPUT TO THE ECM IDENTICAL TO THE SPEEDOMETER UNTIL APPROXIMATELY 85MPH IS ATTAINED. AT THIS POINT THE SPEED SIGNAL INTO ECM REMAINS AT THAT VALUE, BUT SIGNAL TO SPEEDOMETER INCREASES WITH VEHICLE SPEED AS NORMAL. THIS ALLOWS THE ECM TO IGNORE THE PROGRAMED MAXIMUM VEHICLE SPEED VALUE, THAT WOULD OTHER WISE BE OPERATIVE TO LIMIT MAX VEHICLE SPEED.

SPEED DELIMITER SCHEMATIC

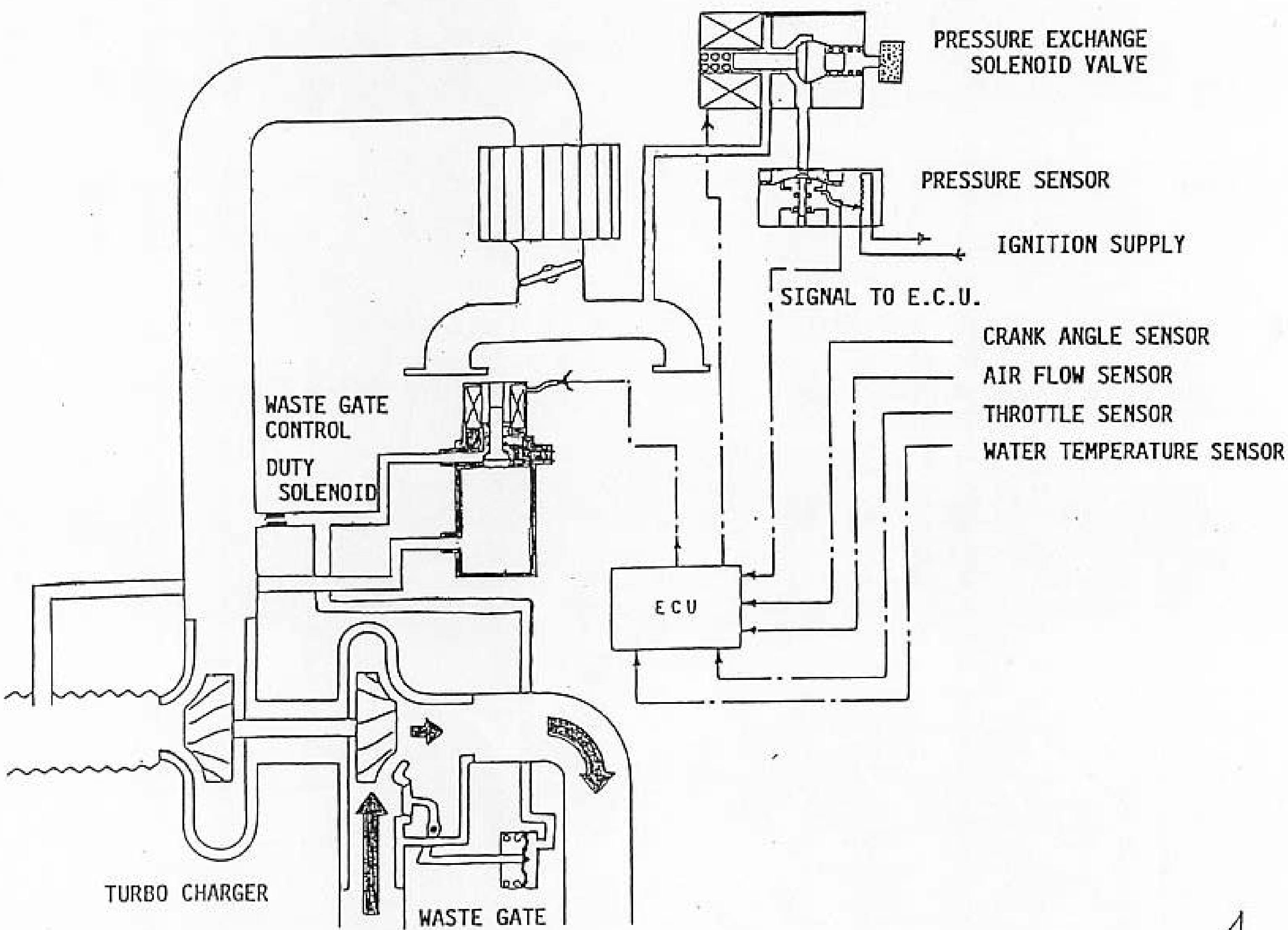
WIRING COLOUR AND CONNECTIONS AS MADE ON THE VEHICLE.
SPARE PART AVAILABLE FROM IM PARTS LTD, IN THE EVENT OF FAILURE OF THE SPEED DELIMITER. PART NO SACC 6018.



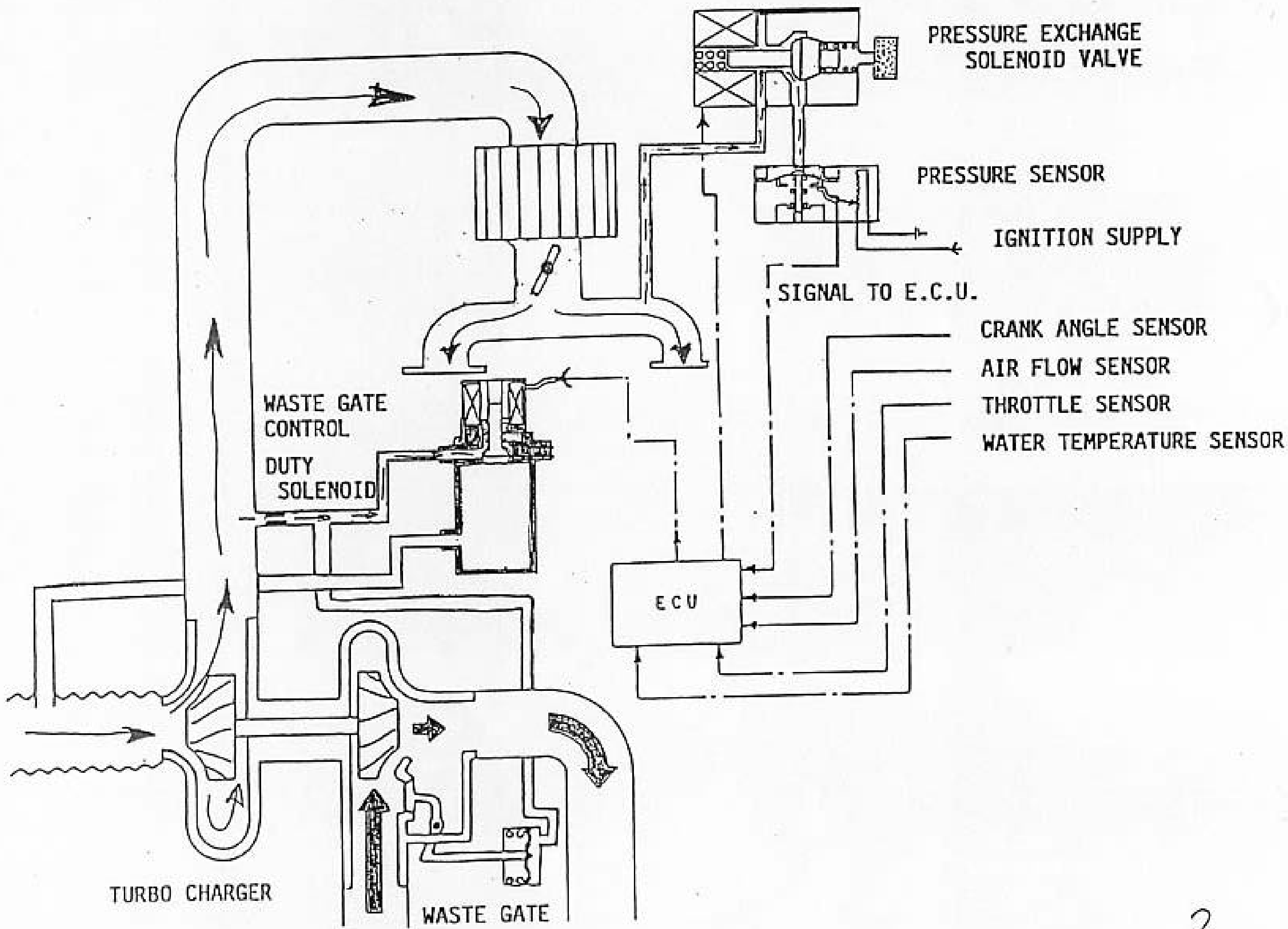
VEHICLE SPEED SENSOR CIRCUIT



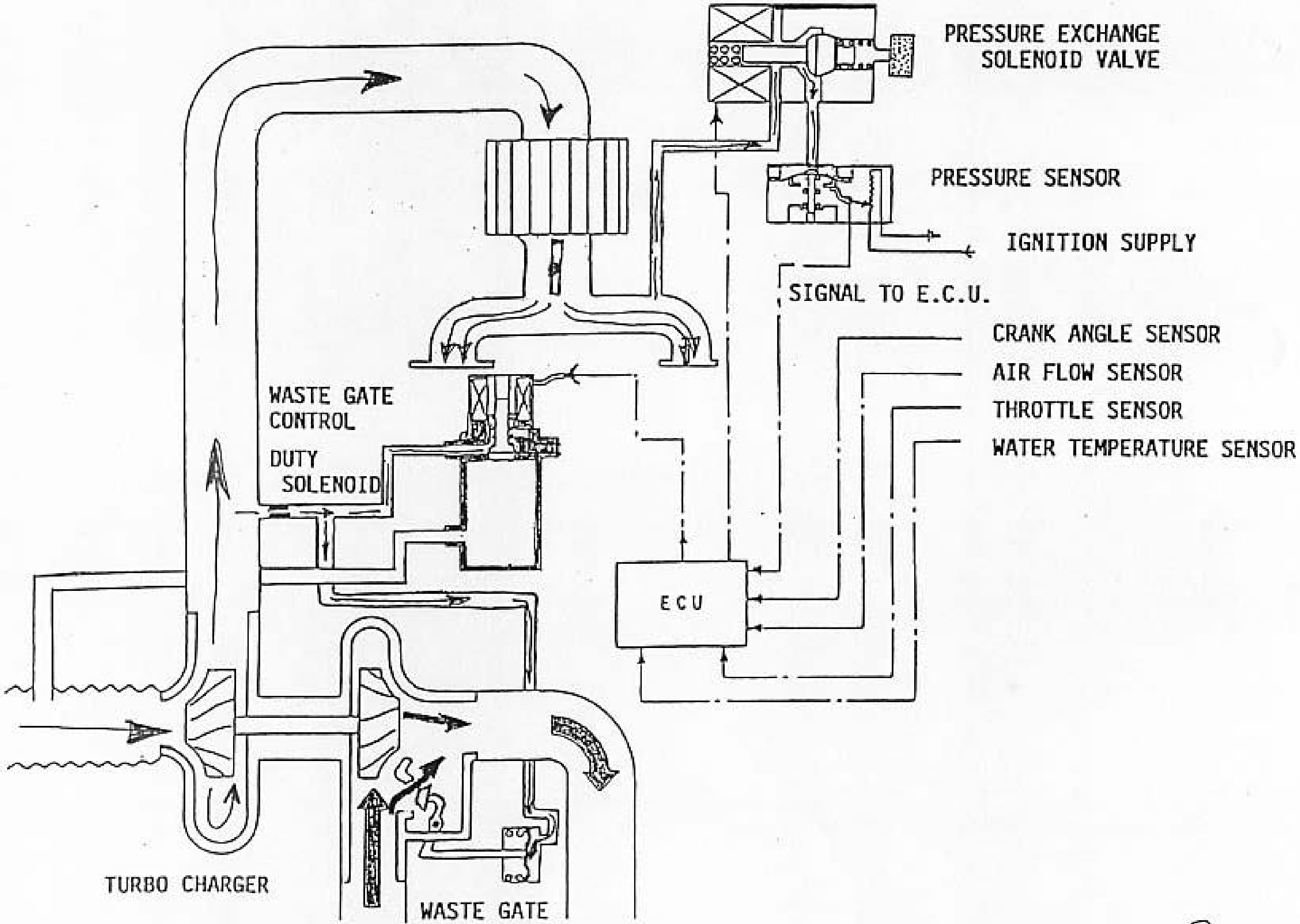
TURBOCHARGER SYSTEM



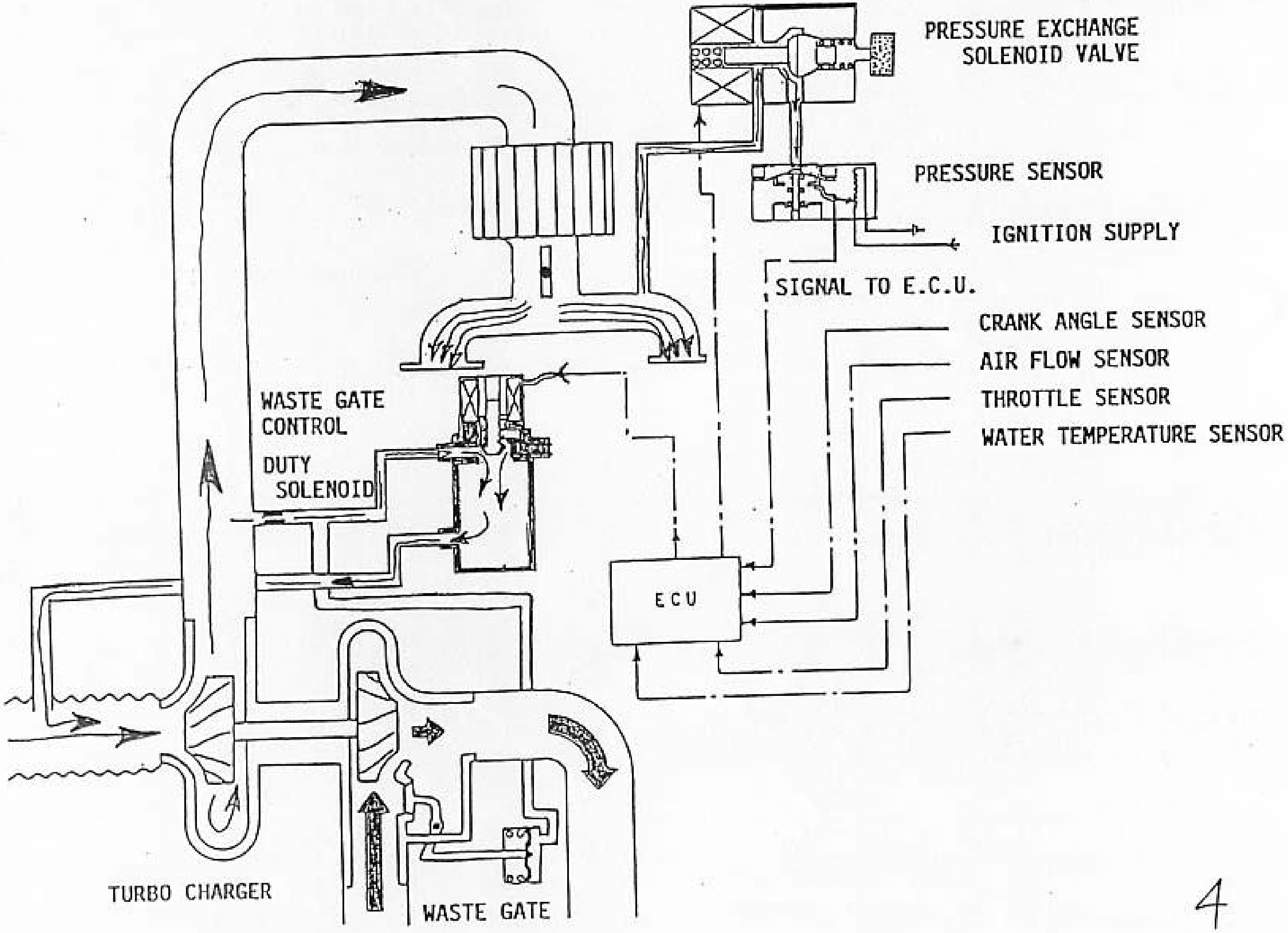
TURBOCHARGER SYSTEM



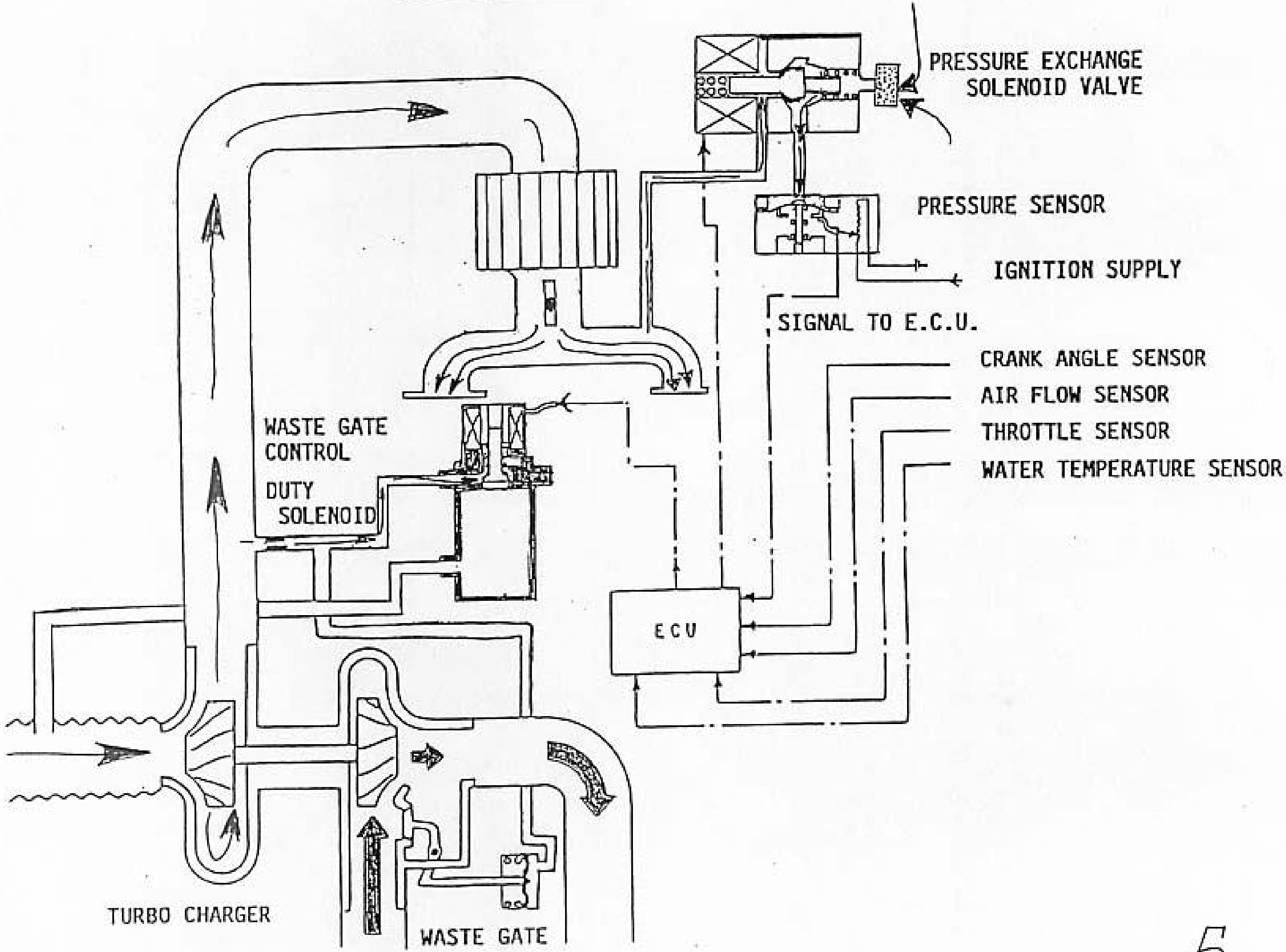
TURBOCHARGER SYSTEM



TURBOCHARGER SYSTEM

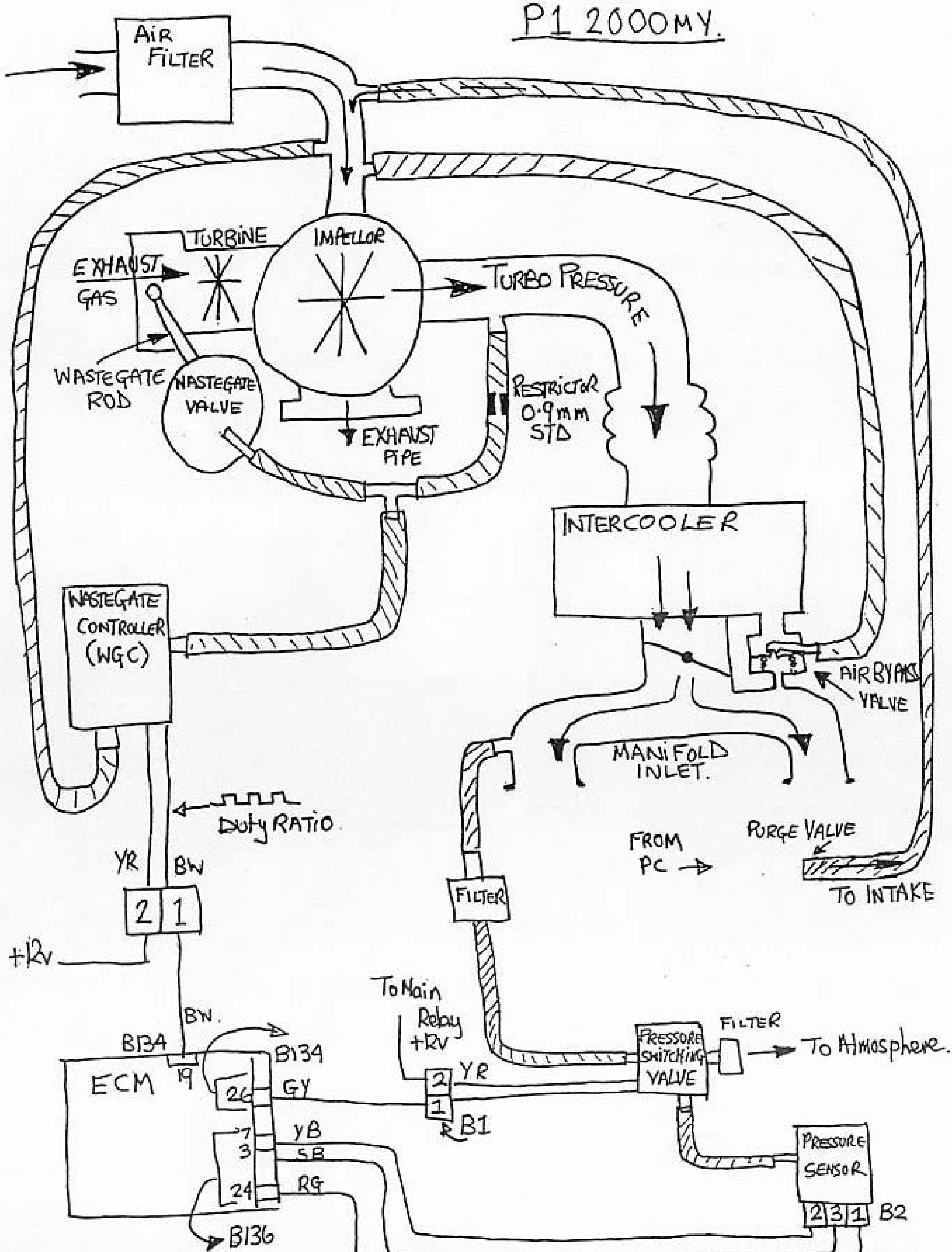


TURBOCHARGER SYSTEM



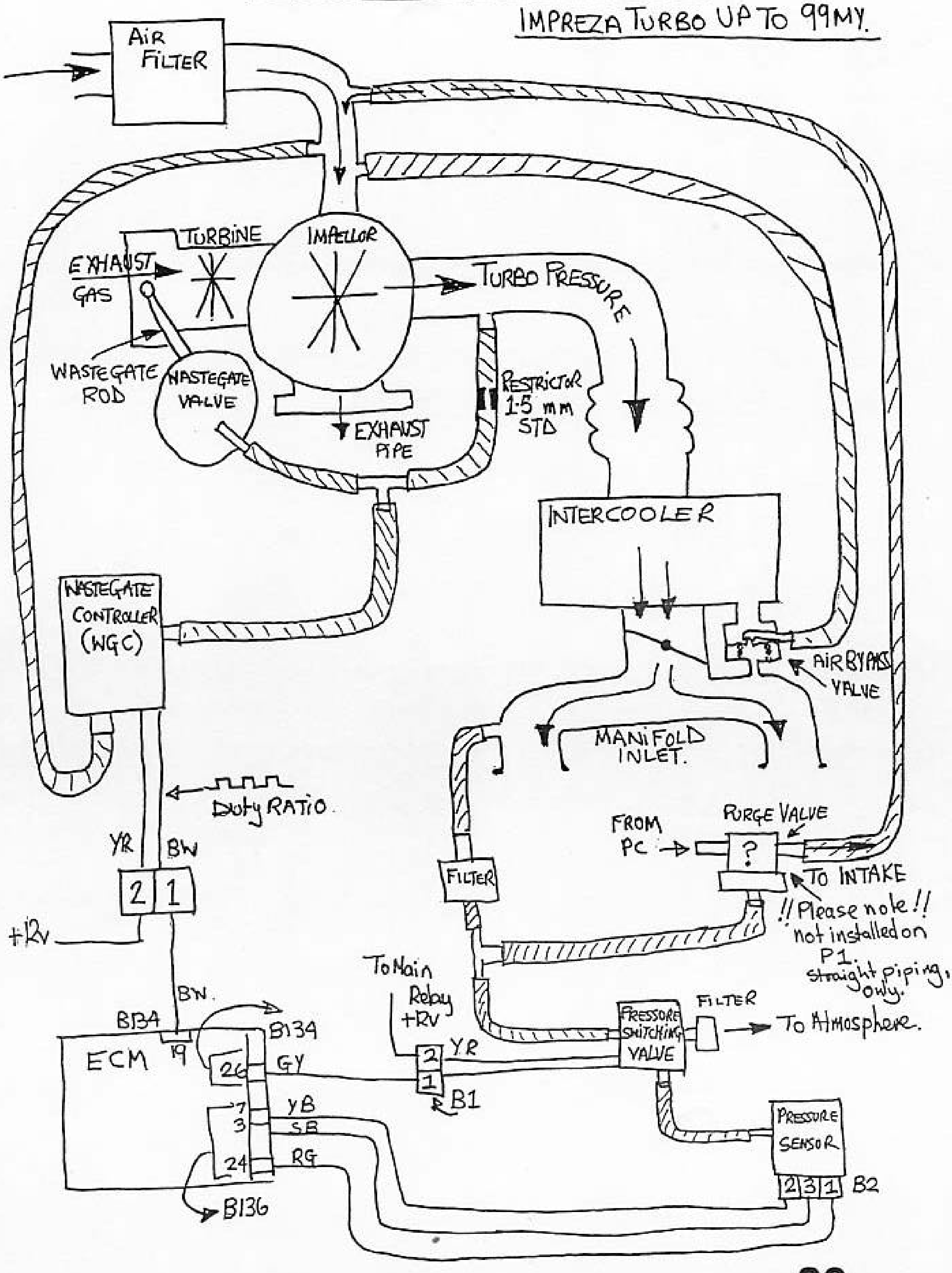
"TURBOCHARGER SYSTEM"

P1 2000MY.

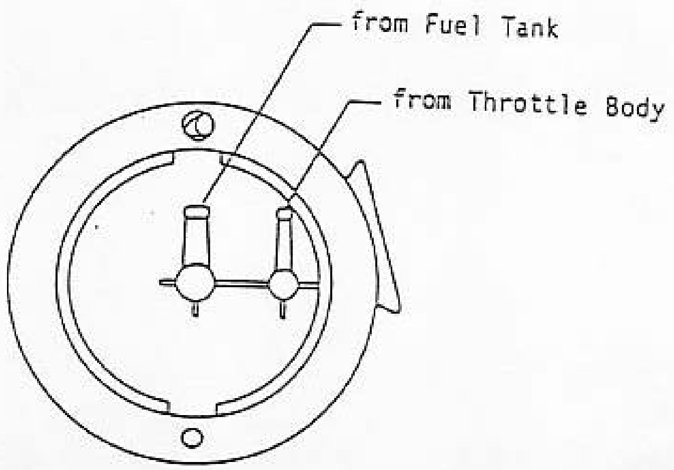


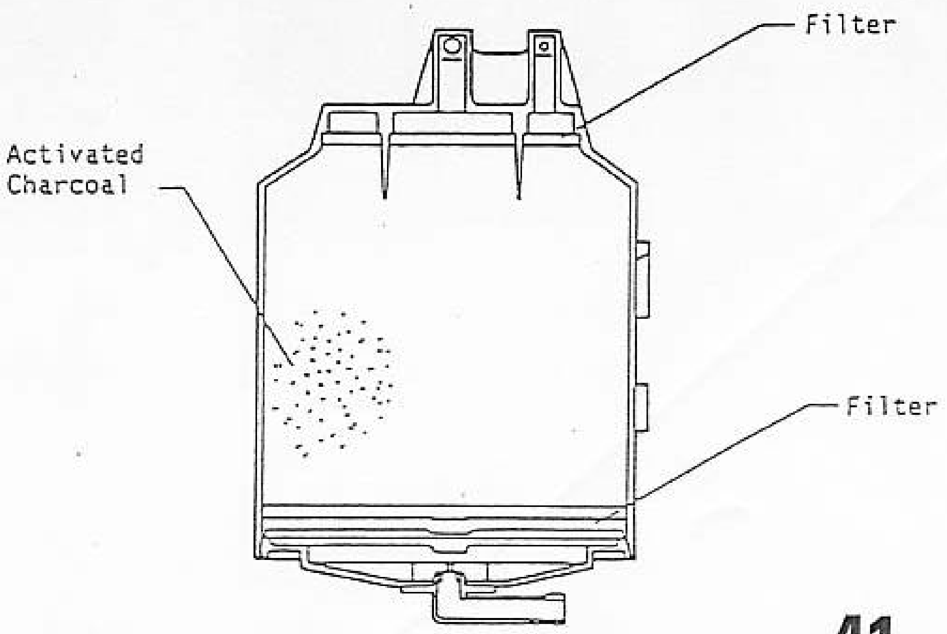
"TURBOCHARGER SYSTEM"

IMPREZA TURBO UP TO 99MY.

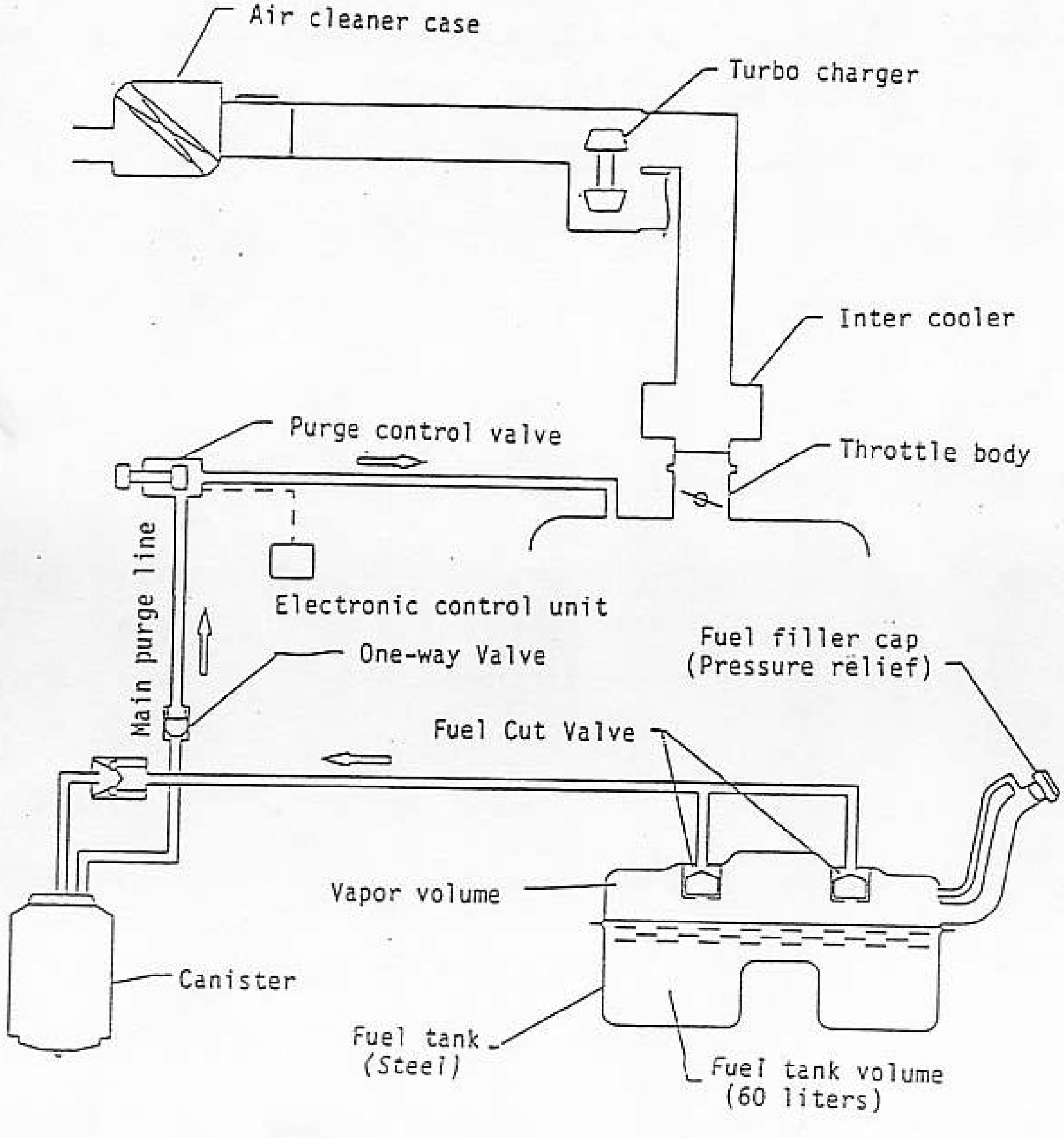


Charcoal canister





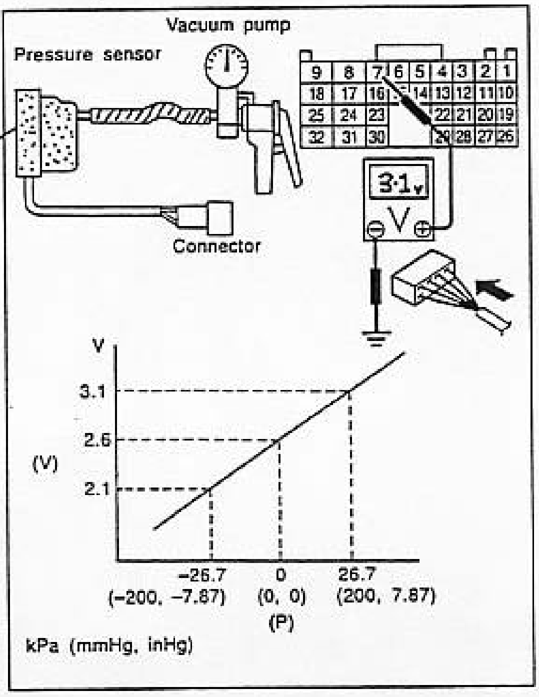
Evaporative emission control system



CHECK PRESSURE SENSOR.

1) Connect connector ECM and pressure sensor.
2) Install vacuum pump to hose fitting on pressure sensor.
3) Measure voltage across terminals when pressure is applied to pressure sensor.

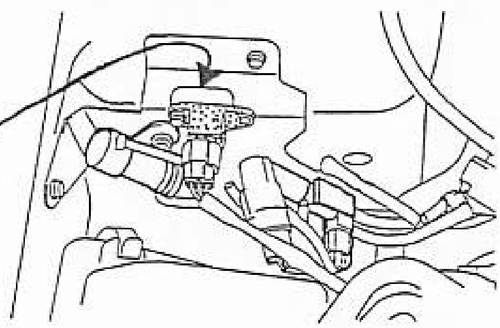
Connector & terminal
(B136) No. 7 (+) — Chassis ground (–):

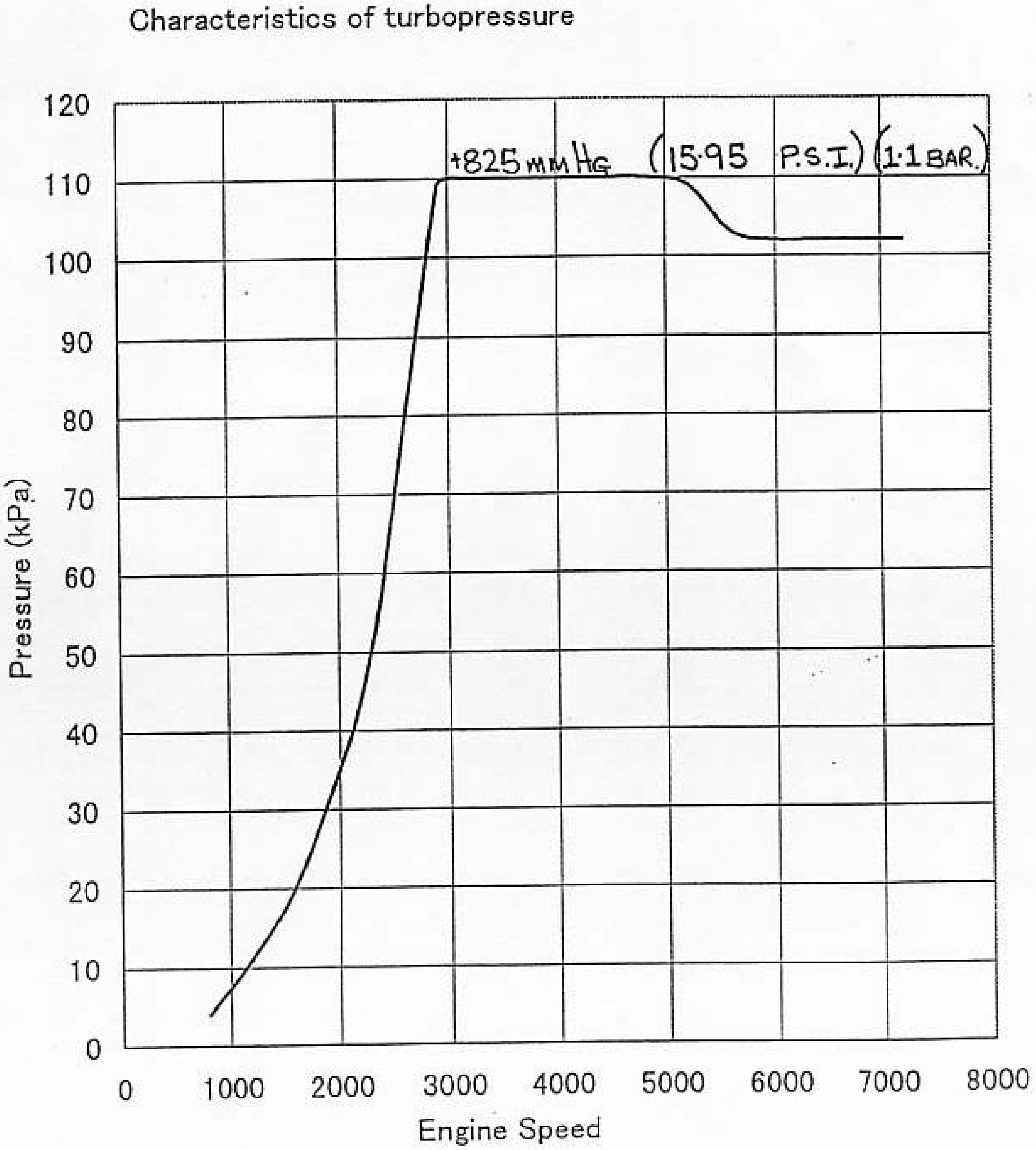


CHECK : *Is the voltage 3.1 V at 26.7 kPa (200 mmHg, 7.87 inHg)?* 3·8 PSI

CHECK : *Is the voltage 2.6 V at 0 kPa (0 mmHg, 0 inHg)?*

CHECK : *Is the voltage 2.1 V at –26.7 kPa (–200 mmHg, –7.87 inHg)?*

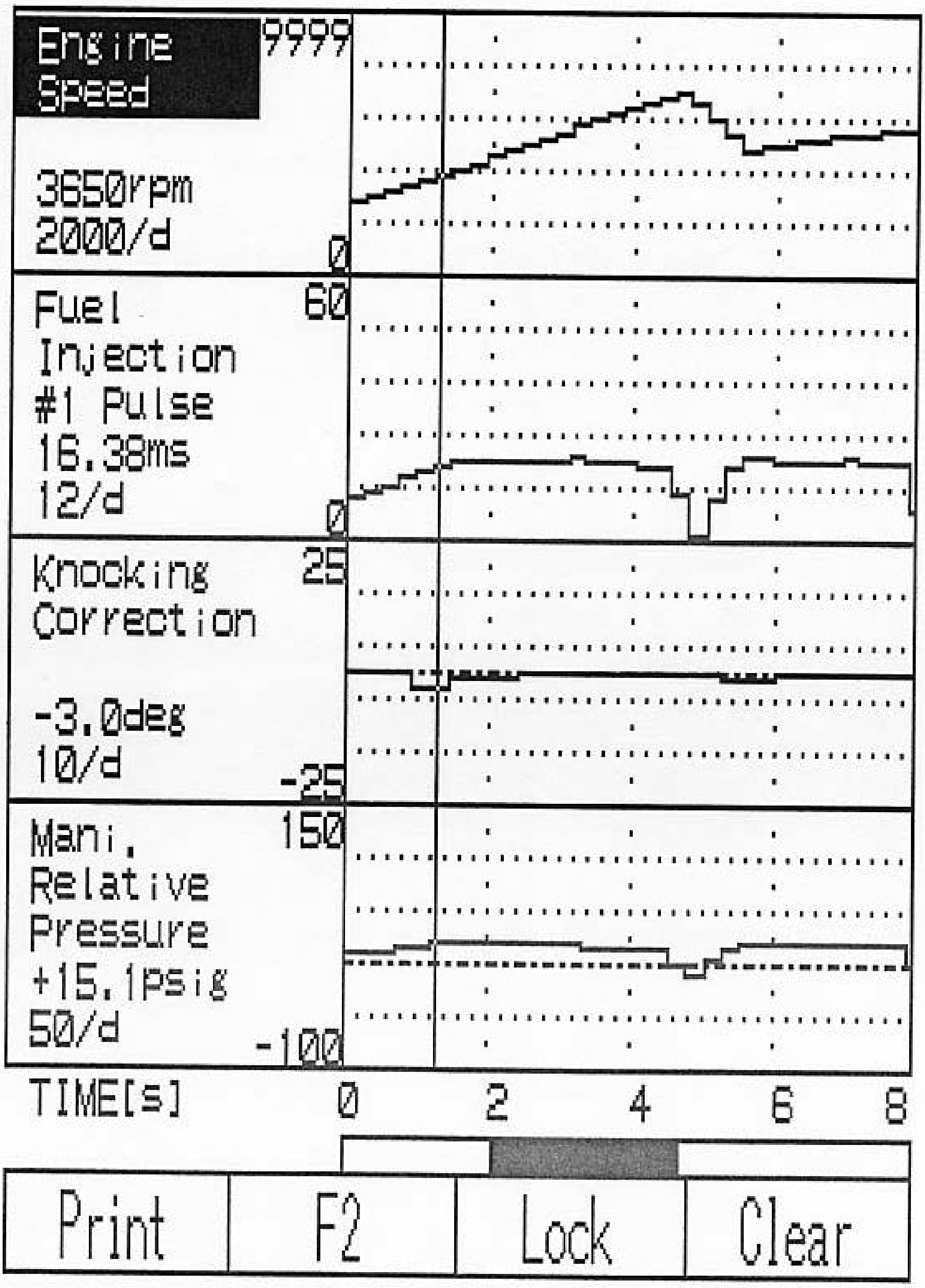




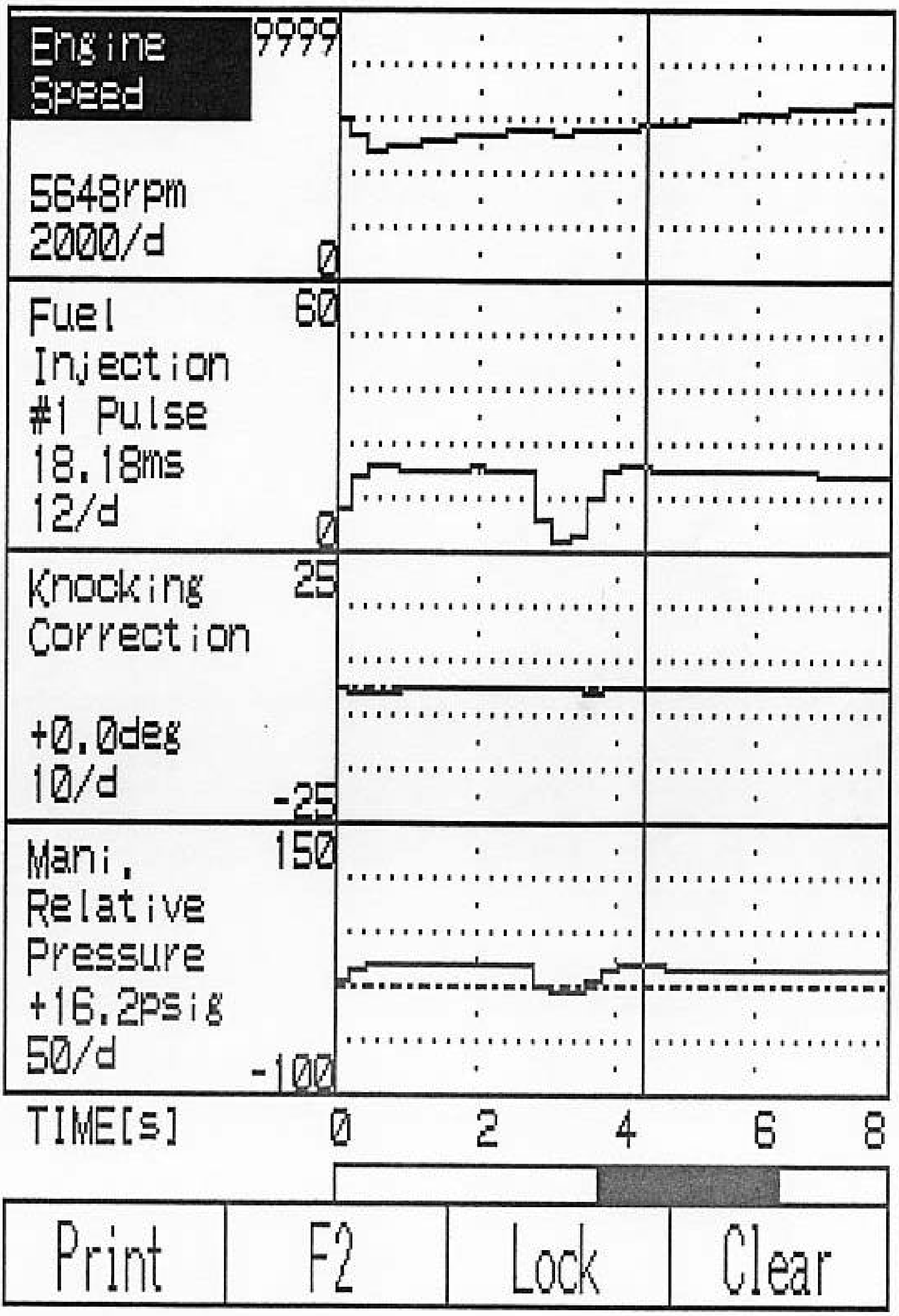
TO CONVERT Kpa to PSI MULTIPLY Kpa by 0.145

Ie 110 * 0.145 = 15.95 psi

P1 USING 95 RON FUEL

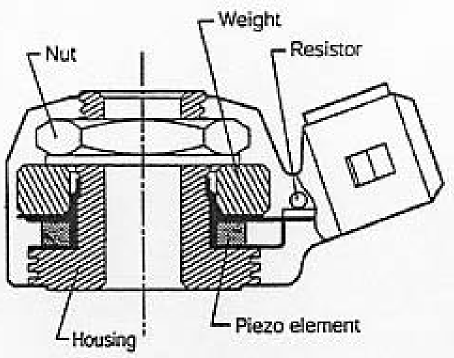


P1 USING 98 RON FUEL



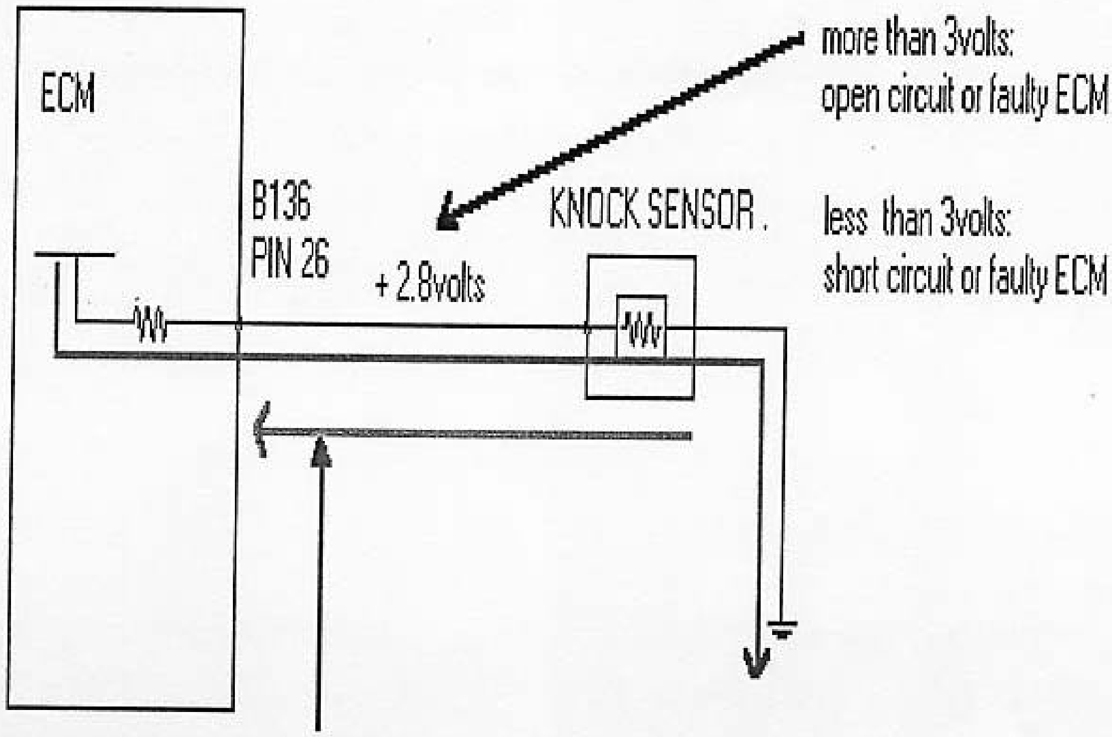
Knock sensor

This sensor is mounted on the cylinder block and detects knocking vibrations of the engine. It consists of a piezo-element, weight and case.
The piezo-element inside of the sensor converts vibration into voltage signal that is output to the ECM. ECM controls ignition timing based on the knock sensor signal.
As sensor signal is detected, ECM retards the ignition timing. When the knocking stops, the ignition timing is advanced again.



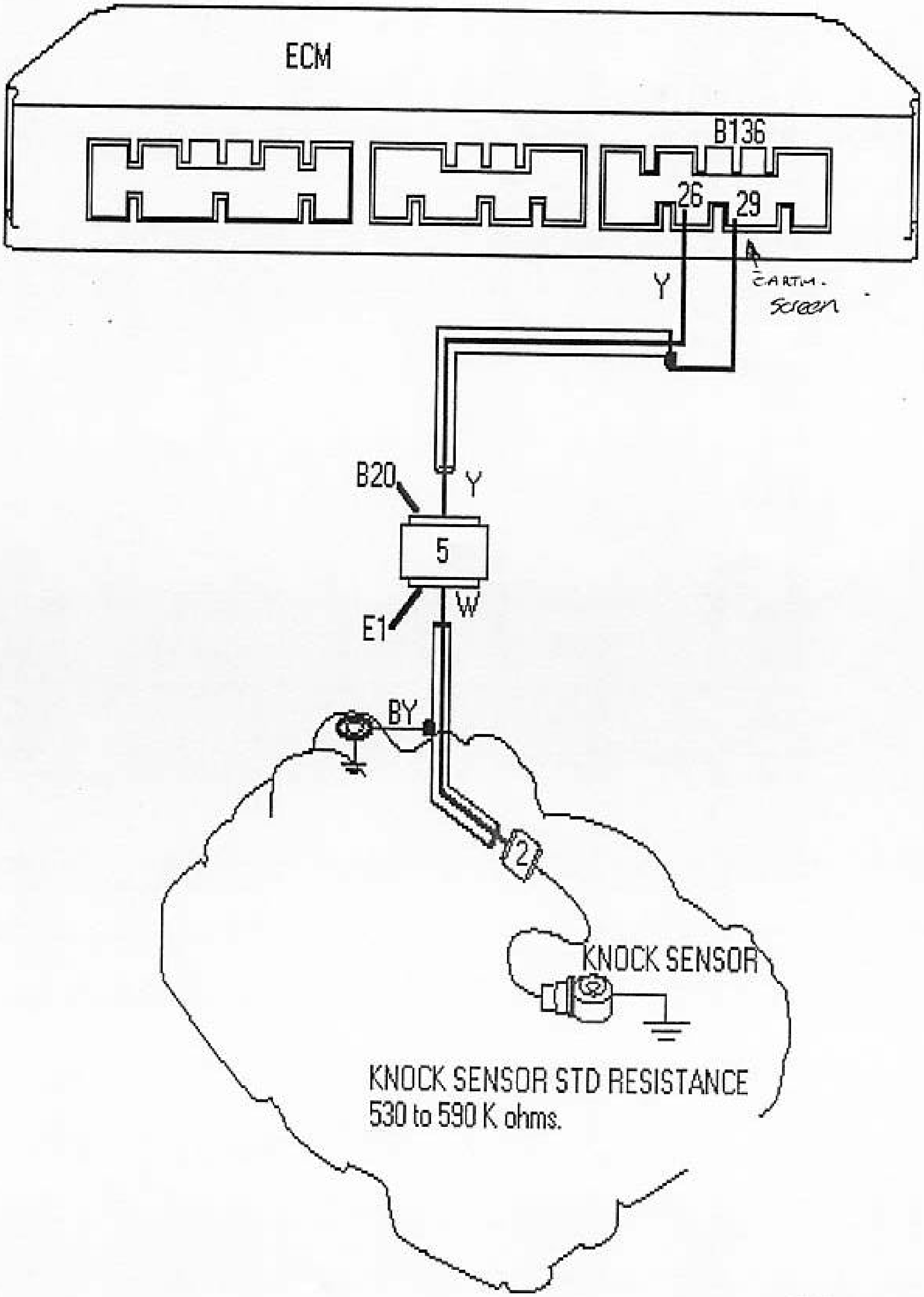
TIGHTENING TORQUE: 21 to 27 N-m (2.1 to 2.7 Kg-m) (15.2 to 19.6 ft-lb)

KNOCK SENSOR SCHEMATIC PIEZO - ELECTRIC ELEMENT TYPE.



PIEZO GENERATED VOLTAGE OPPOSING ECM SUPPLY : DETONATION DETECTED.

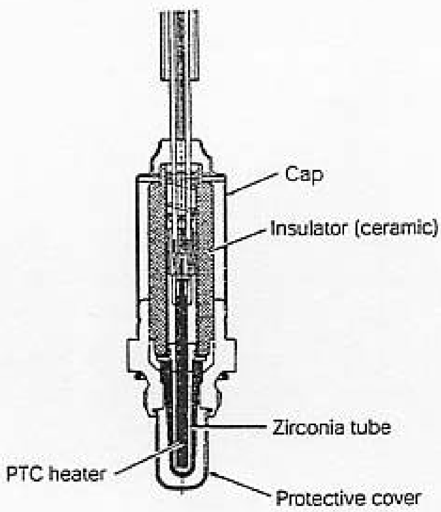
KNOCK SENSOR CIRCUIT



Oxygen Sensor

The oxygen (O_2) sensor detects the density of oxygen contained in exhaust gas. The oxygen density signal from this sensor provides the ECM with important feedback that can be applied to maximize the efficiency of the three-way catalyst (TWC) of the catalytic converter.

The oxygen sensor is a type of battery made up of a zirconia tube, a protective cover, an insulator, and lead wires. The zirconia tube is a test tube shaped zirconia element (a solid electrolyte named zirconium oxide: ZrO_2).



O2 SENSOR VOLTAGE OUTPUT:
0.1 to 0.9 volt, TRANSITION POINT 0.45volt.

O2 Crosspoints : 8 to 18: per 5 seconds: STD.

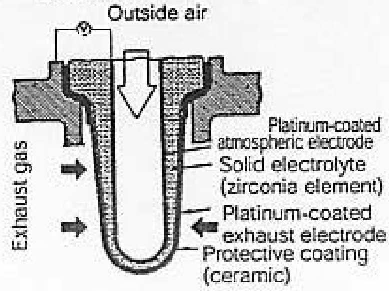
Low voltage output from O2:
Sensor equals a weak mixture, i.e. 0.2-volt.

High voltage output from O2 :
Sensor equals a rich mixture, i.e. 0.7-volt.

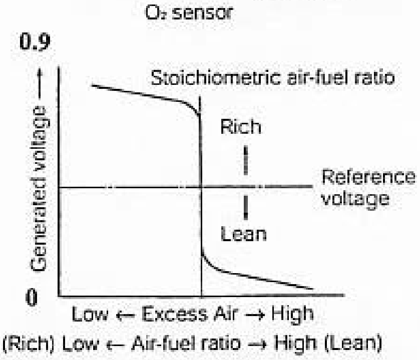
Both sides of the zirconia tube are coated with a thin layer of platinum, which acts as a catalyst. The outside coating is exposed to exhaust gas, while the inside is exposed to outside air. When the sensor is heated by exhaust gas to a temperature of 300°C to 400°C, the zirconia tube generates voltage in accordance with the oxygen density differential between the interior of the tube and the exterior of the tube.

Combustion of a rich air-fuel mixture produces exhaust gas with relatively high levels of carbon monoxide (CO). The platinum catalyst acts to bind the CO and the oxygen in the exhaust gas, which results in an extremely low level of oxygen. This causes the oxygen density differential between the interior and exterior of the sensor to be large, generating higher voltage.

In the case of a lean mixture, the exhaust gas has a relatively high level of oxygen. Since there is little CO, there is little oxygen loss by the binding action of the catalyst. The result is little oxygen density differential between the interior and exterior of the sensor, and generation of little voltage.



O_2 sensor

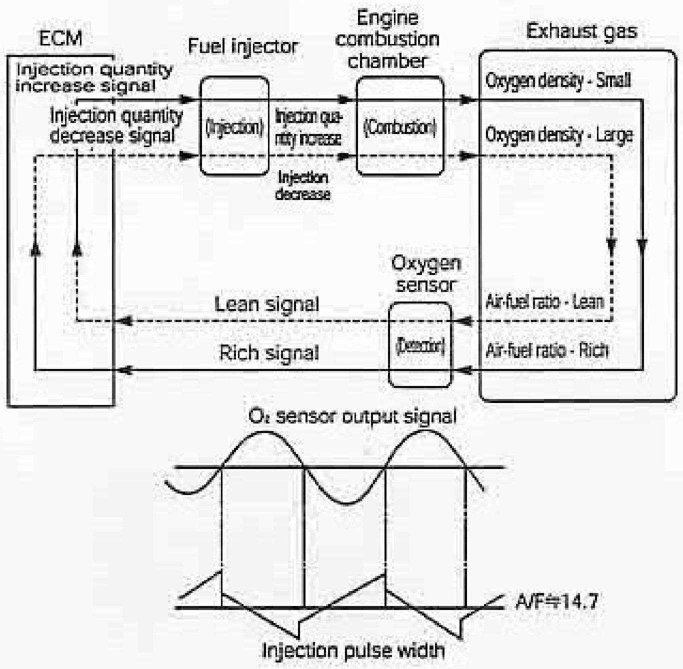


O_2 Sensor Output Characteristics

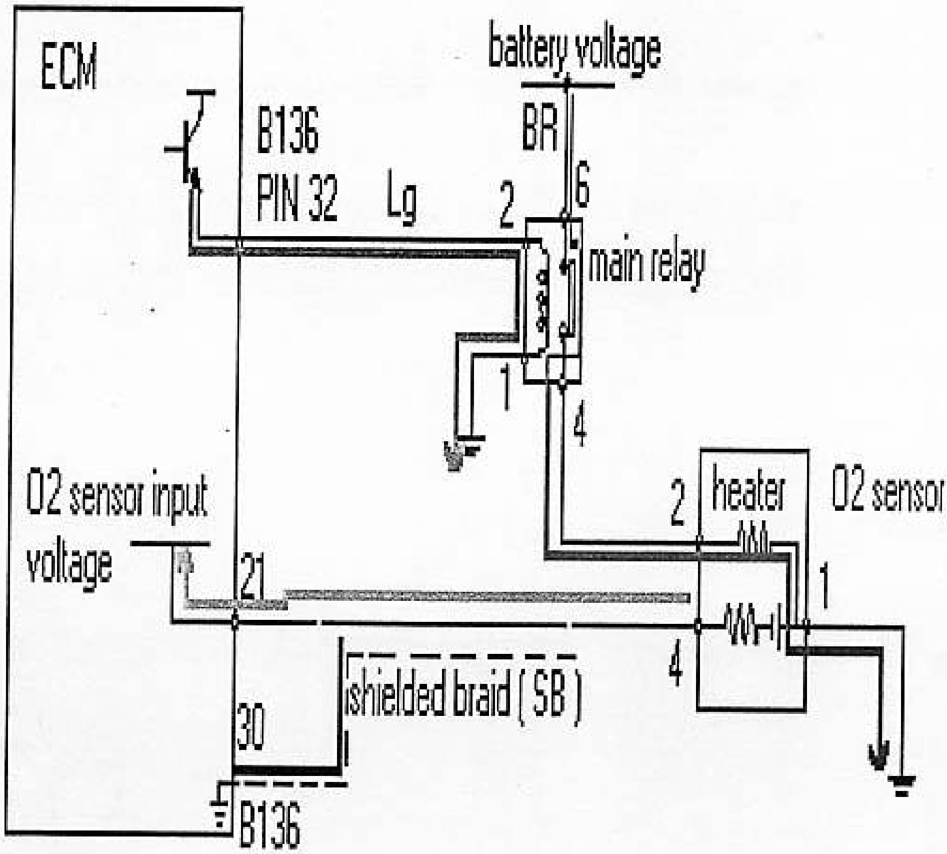
Oxygen Sensor Feedback control

The purpose of the oxygen sensor is to achieve cleaner emissions. It detects the oxygen density of combustion gas and increases or decreases the amount of fuel in the air-fuel mixture in order to keep it as near the stoichiometric air-fuel ratio as possible.

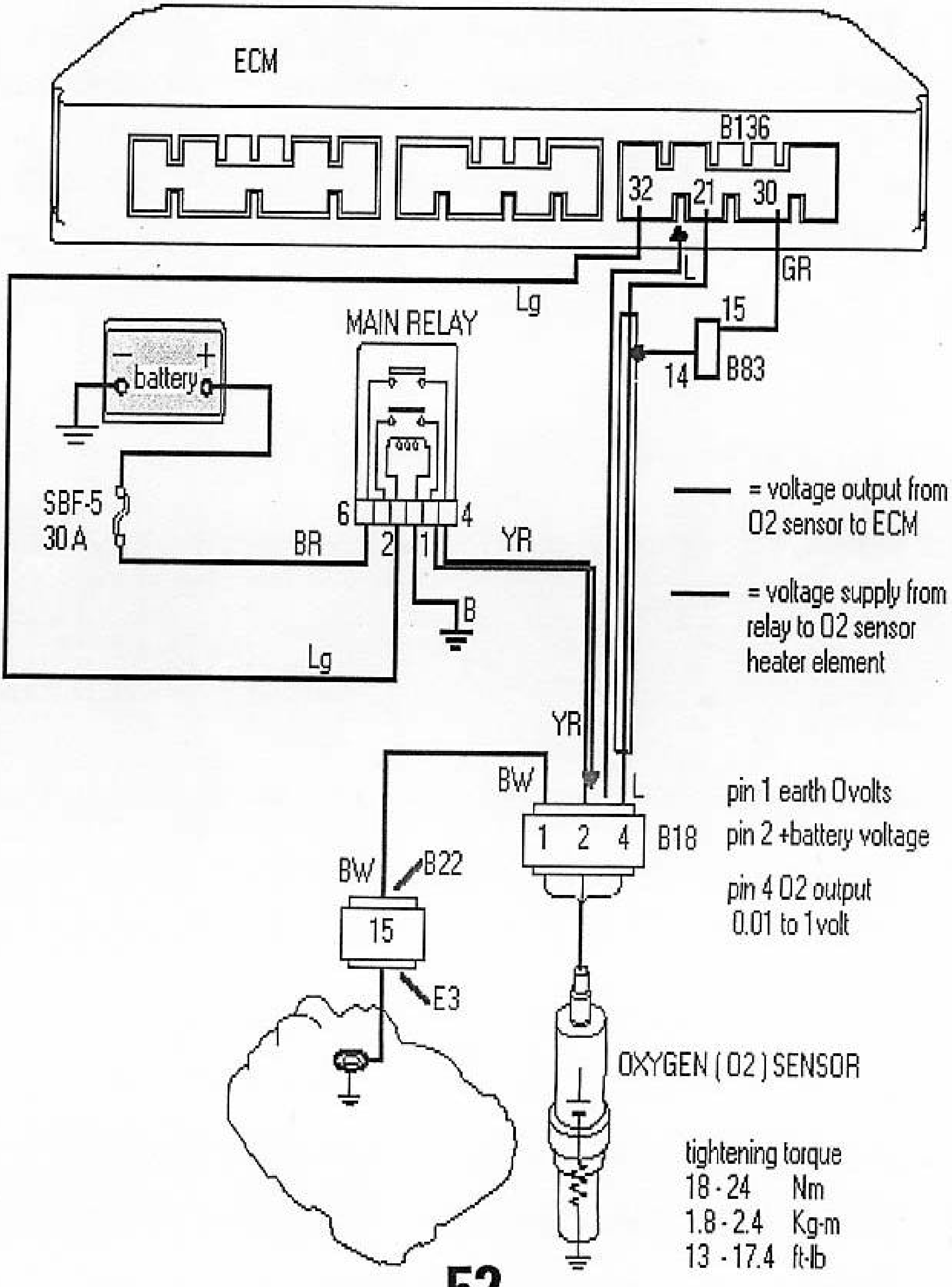
Control is performed in accordance with an oxygen sensor voltage signal sent to the ECM: low voltage indicates a mixture that is leaner than the stoichiometric air-fuel ratio, while high voltage indicates a relatively rich air-fuel mixture. The fuel injection volume is increased or decreased to maintain it close to the stoichiometric air-fuel ratio, which optimizes three-way catalyst performance.



OXYGEN SENSOR SCHEMATIC

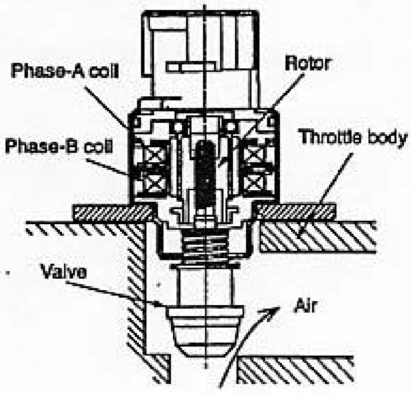


OXYGEN SENSOR CIRCUIT



Stepping motor type idle air control valve

This type of idle air control valve consists of coils, rotor, valve, etc.. This idle air control valve contributes very little to the buildup of carbon and other dirt, so that it has superior durability and stability.

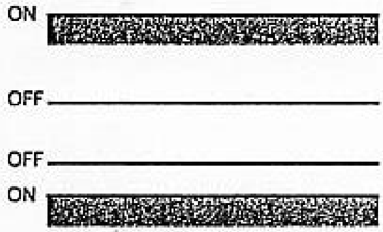


The idle air control valve uses a stepping motor that intermittently supplies current to two phase-A coils and two phase-B coils according to signals from the ECM, operating a rotor that moves the valve up and down by a screw action and thereby controls the valve opening.

The ECM calculates the ideal target idling speed for the engine conditions, and the idle air control valve is controlled regarding the existing idling speed so that the valve opening approaches the target value.

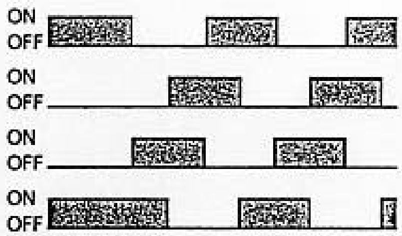
When the stepping motor is off

When the stepping motor is off, two phase excitation is maintained at the phases that correspond to the final position of the valve open/closed motion.



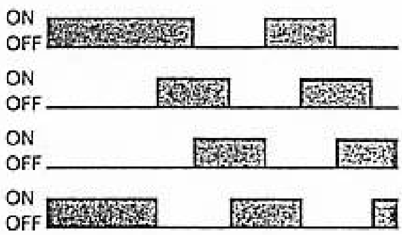
Valve opening operation

During opening operation, two phases are excited in the following sequence: phases 1 and 4 → phases 4 and 3 → phases 3 and 2 → phases 2 and 1.→ phases 1 and 4 →....



Valve closing operation

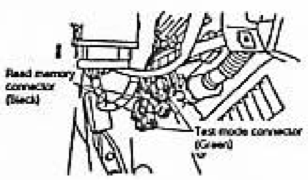
During closing operation, two phases are excited in the following sequence: phases 1 and 2 → phases 2 and 3 → phases 3 and 4 → phases 4 and 1 → phases 4 and 1 → .....



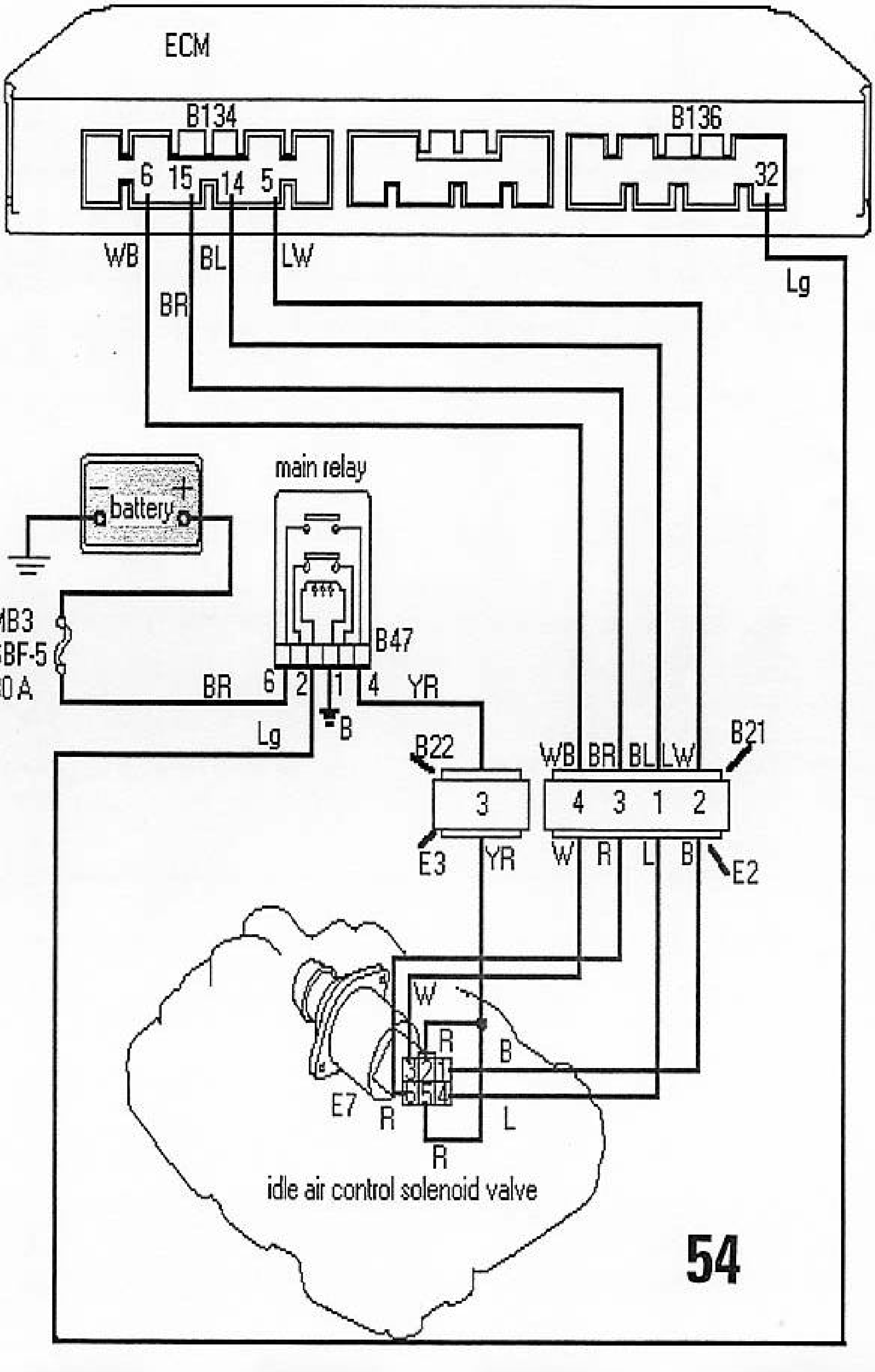
Initialization procedure of idle air control solenoid

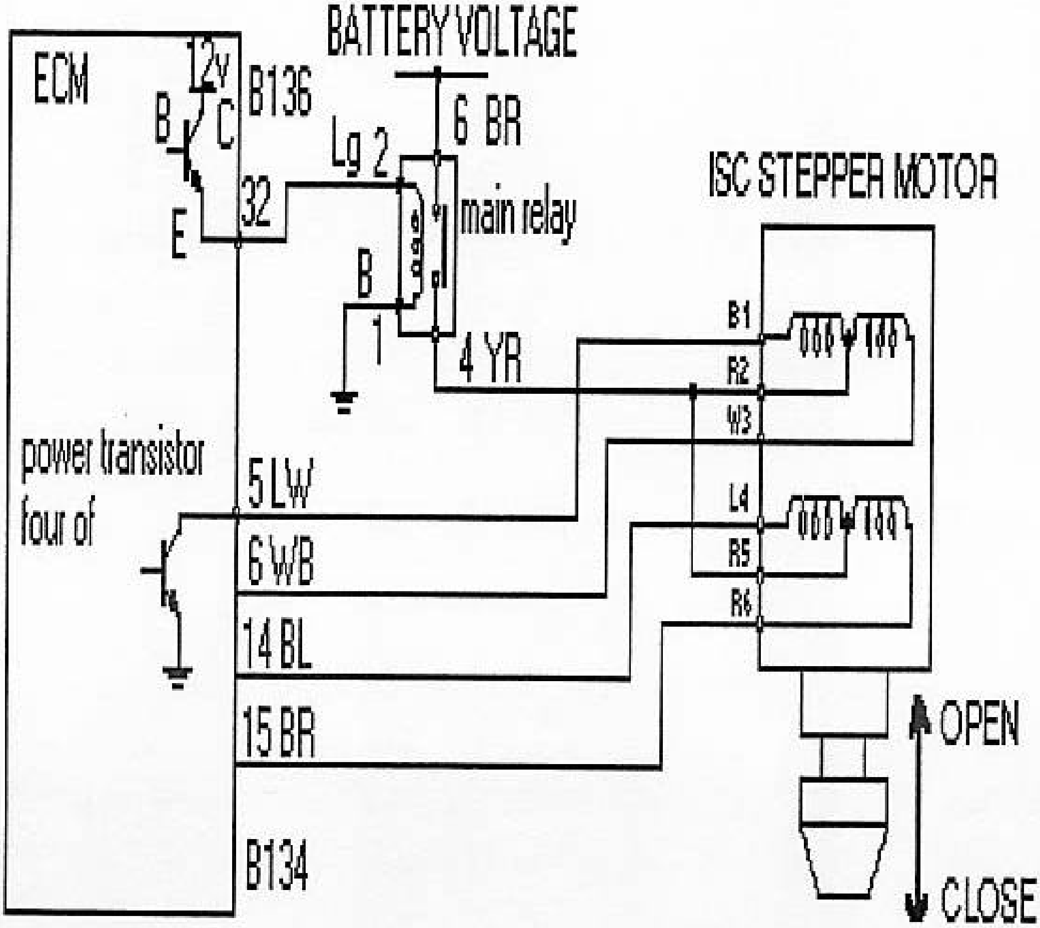
1. Turn the ignition switch OFF.
2. Connect the test mode connector.
3. Turn the ignition switch ON (engine OFF).
4. Wait three seconds.
5. Turn the ignition switch OFF.
6. Wait three seconds.
7. Turn the ignition switch ON (engine OFF).
8. Wait three seconds.
9. Turn the ignition switch OFF.

END (Disconnect the test mode connector.)



IDLE CONTROL SOLENOID CIRCUIT (ISC)

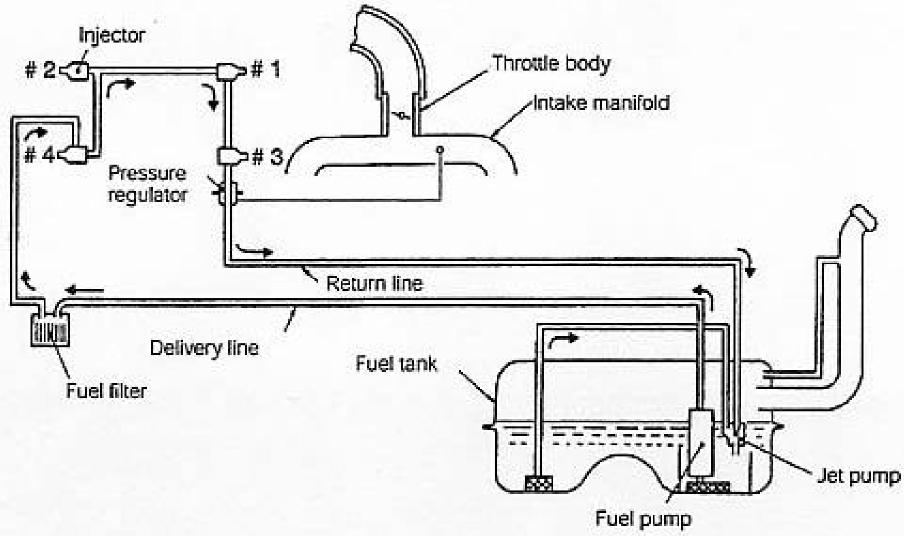



BATTERY VOLTAGE
ECM
12v
B136
B
C
E
32
Lg 2
6 BR
main relay
B
1
4 YR
ISC STEPPER MOTOR
B1
R2
W3
L4
R5
R6
power transistor
four of
5 LW
6 WB
14 BL
15 BR
B134
OPEN
CLOSE

Fuel System

The fuel system delivers the fuel required for combustion. Fuel sent to the injector from the fuel tank by the fuel pump is maintained at a specified pressure that is always greater than the intake manifold internal pressure by constant value. Fuel is injected into the intake manifold by the injector in accordance with injection signals from the ECM.

Today, the most common fuel system uses multi-point Fuel injection (MFI), which equips an injector at the intake port of each cylinder.The MFI system allows a high level of intake air system design, high-precision air-fuel ratio control, along with exceptional output, fuel economy, and exhaust gas characteristics.



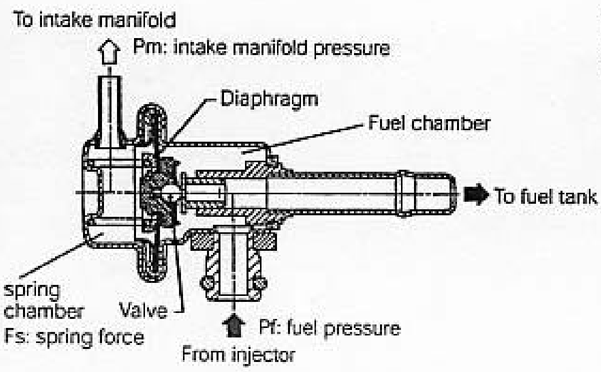
Pressure Regulator

The pressure regulator consists of a valve, valve seat, spring, and diaphragm, and it is divided into a fuel chamber and spring chamber.

The spring chamber is connected to the intake manifold and the diaphragm moves in accordance with the balance between fuel pressure on one side of the diaphragm, and intake manifold pressure and spring force on the other side.

When intake manifold pressure drops due to a change in engine load, the diaphragm moves and the valve opens, which increases volume of the fuel to return to the fuel tank to reduce fuel pressure. A rise in intake manifold pressure, on the other hand, closes the valve and causes fuel pressure to rise.

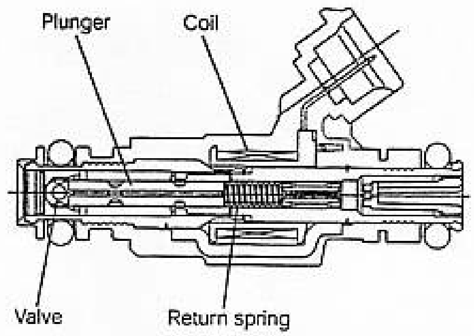
The repeated opening and closing of the valve keeps the pressure differential between the fuel being sent to the injector and the intake manifold negative pressure at a constant level at all times.



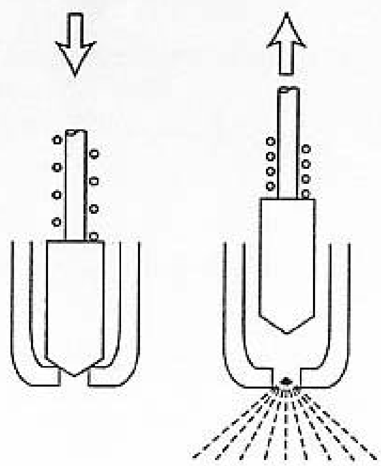
Pf - Pm = Fs(constant)/A
A: diaphragm surface area

Injector

The injector is nothing different to the solenoid valve. When the injection signal from the ECM comes to the injector, its electromagnetic coil energizes, and the magnetic force of the coil lifts a plunger to open the valve, causing fuel to be injected. When the coil is not energized, the valve is pushed close by a return spring.



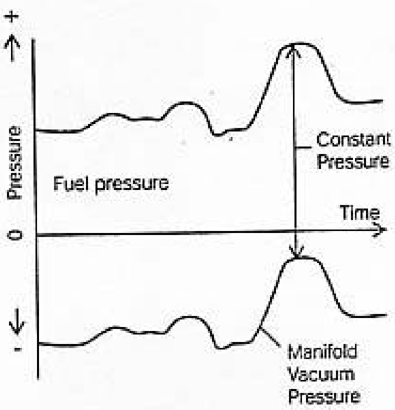
The nozzle of an injector is designed to optimize fuel droplet diameter and width of the spray.



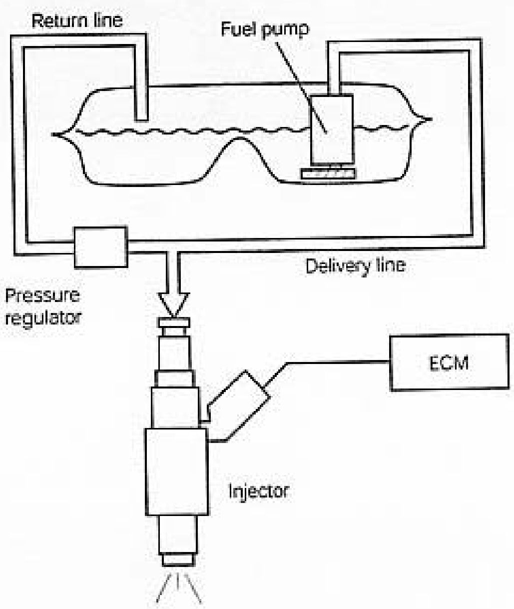
Fuel injection amount

Fuel pressurized by a fuel pump is delivered to the fuel injectors by way of fuel delivery line and the fuel pressure is kept at a constant level against the intake manifold pressure by the pressure regulator at all times.

The amount of the fuel injected into the manifold is controlled by the length of time the fuel injector is opened.



Since the injector opening, the lift level of the valve and the regulator-controlled fuel pressure are kept constant, the amount of the fuel to be injected can be controlled only by the length of the valve opening signal from the ECM.



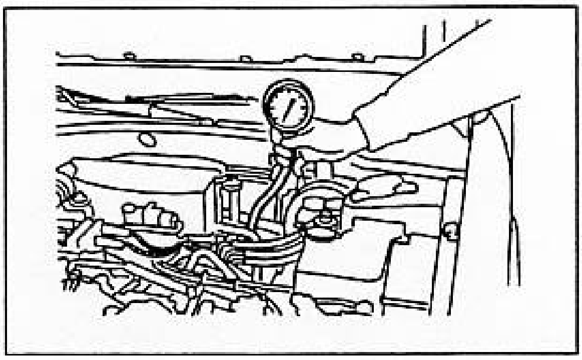
Injection Timing

There are four types of injection timing: simultaneous injection, sequential injection, group injection, and single-point injection. Here we consider sequential injection only.

Cylinders in a sequential injection system are controlled separately, and fuel is injected into each cylinder just before the intake stroke. The appropriate volume of fuel required for combustion is controlled individually for each cylinder. All cylinders are injected simultaneously for engine starts, and injection time is extended at high engine-load condition,

Cylinder Number No.	One cycle (One rotation)			
# 1	Exhaust	Intake	Compression	Combustion
# 3	Combustion	180° Exhaust	Intake	Compression
# 2	Compression	Combustion	180° Exhaust	Intake
# 4	Intake	Compression	Combustion	180° Exhaust

3. Intake manifold vacuum



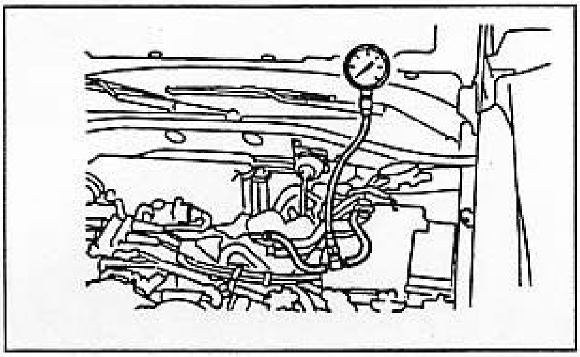
1. After allowing the engine to warm up fully, connect a vacuum gauge to the intake manifold vacuum hose.
2. Read the value indicated on the vacuum gauge at idle speed.

Measured value:

Standard value:

- 599.95 hPa (- 450 mmHg)
(A/C off) **-17.7 ins Hg**

4. Fuel pressure



1. Disconnect the fuel pump connector.
2. Start the engine and wait for the engine to stall.
3. Once the engine has stalled, turn the starter motor for 5-7 seconds and fully release the pressure in the fuel line.
4. Take off the fuel fillter cap.
5. Reconnect the fuel pump connector.
6. Remove the delivery hose from the fuel damper and attach a fuel pressure gauge.
7. Start the engine.
8. Read the gauge reading with the pressure regulator vacuum hose connected.

Measured value:

Standard value:

205.94 – 238.36 KPa (2.1 – 2.4 kg/cm²)
30 to 35 psi

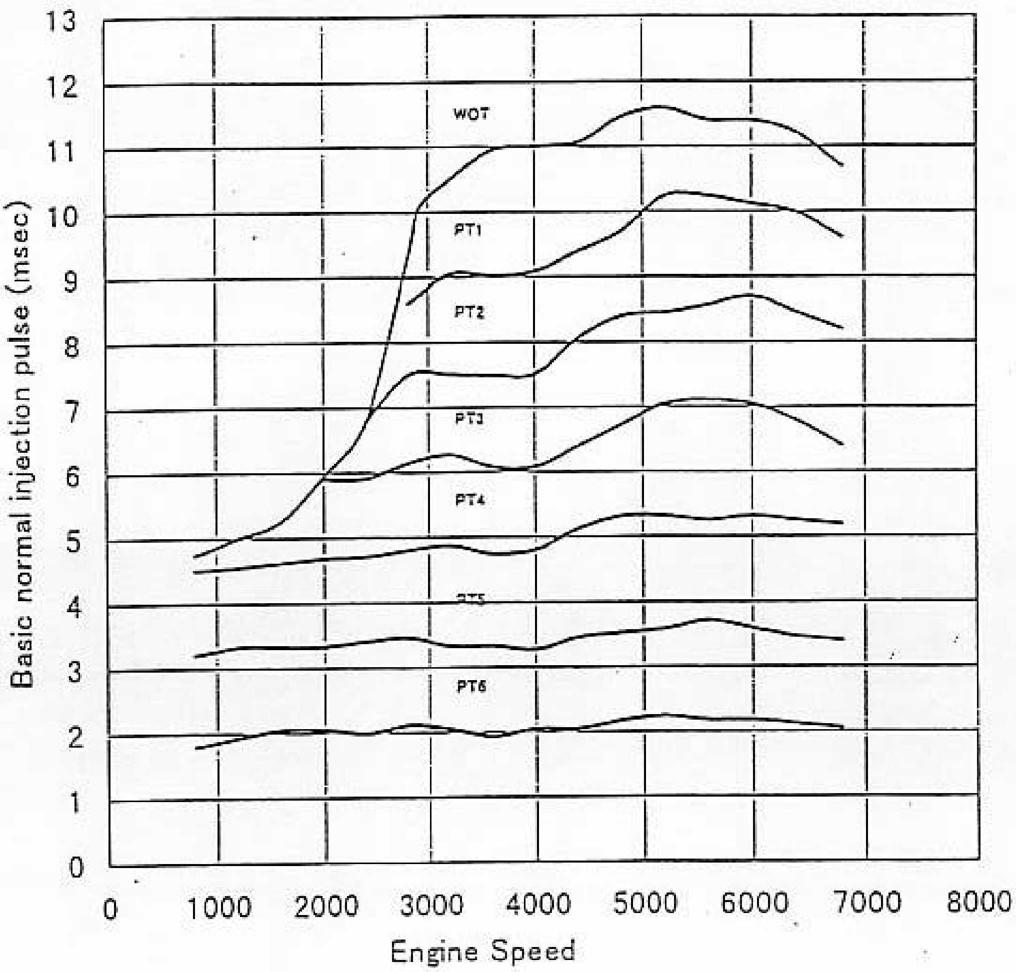
9. Read the gauge reading with the pressure regulator vacuum hose disconnected.

Measured value:

Standard value:

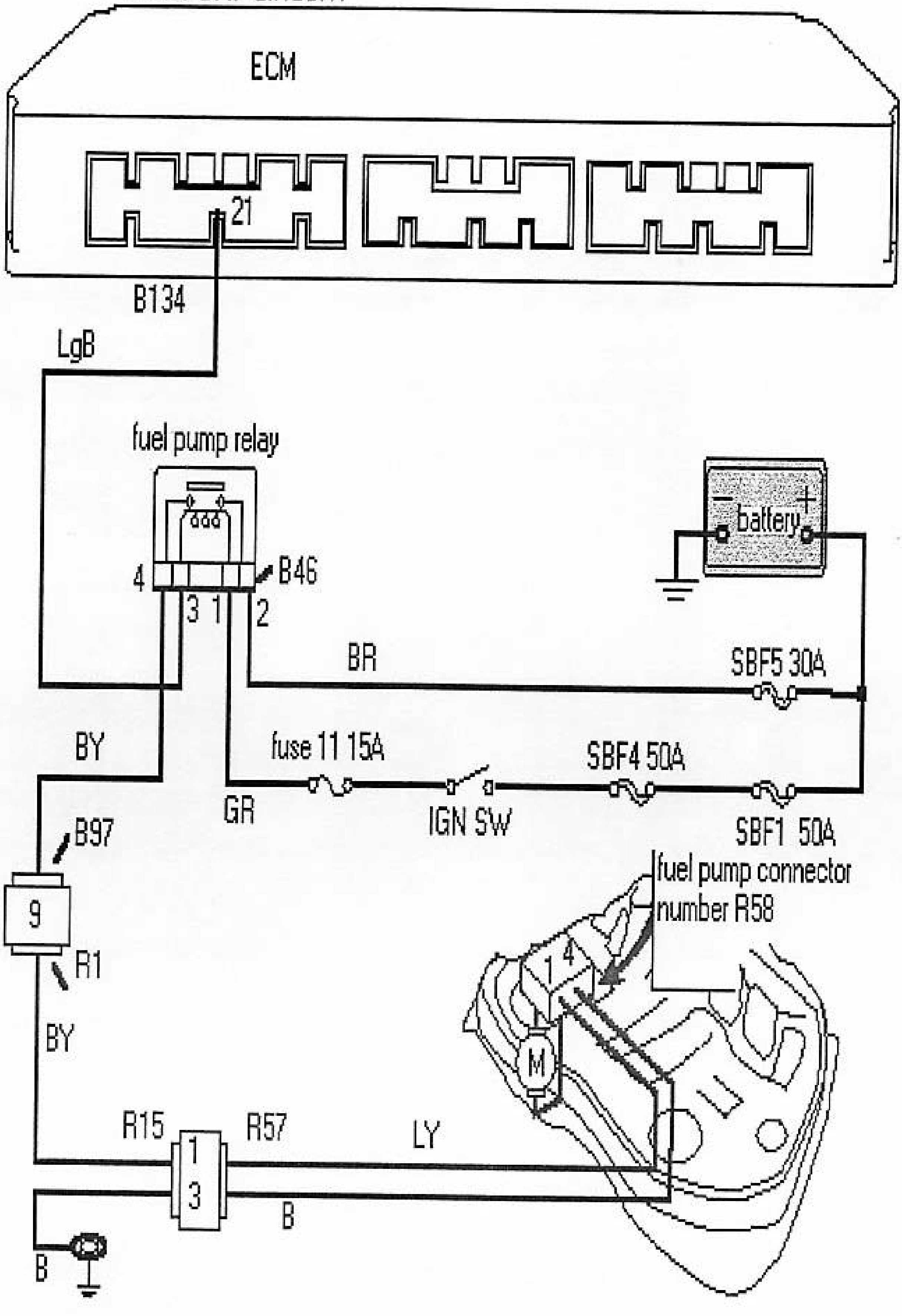
284.39 – 313.81 KPa (2.9 – 3.2 kg/cm²)
41 to 46 psi

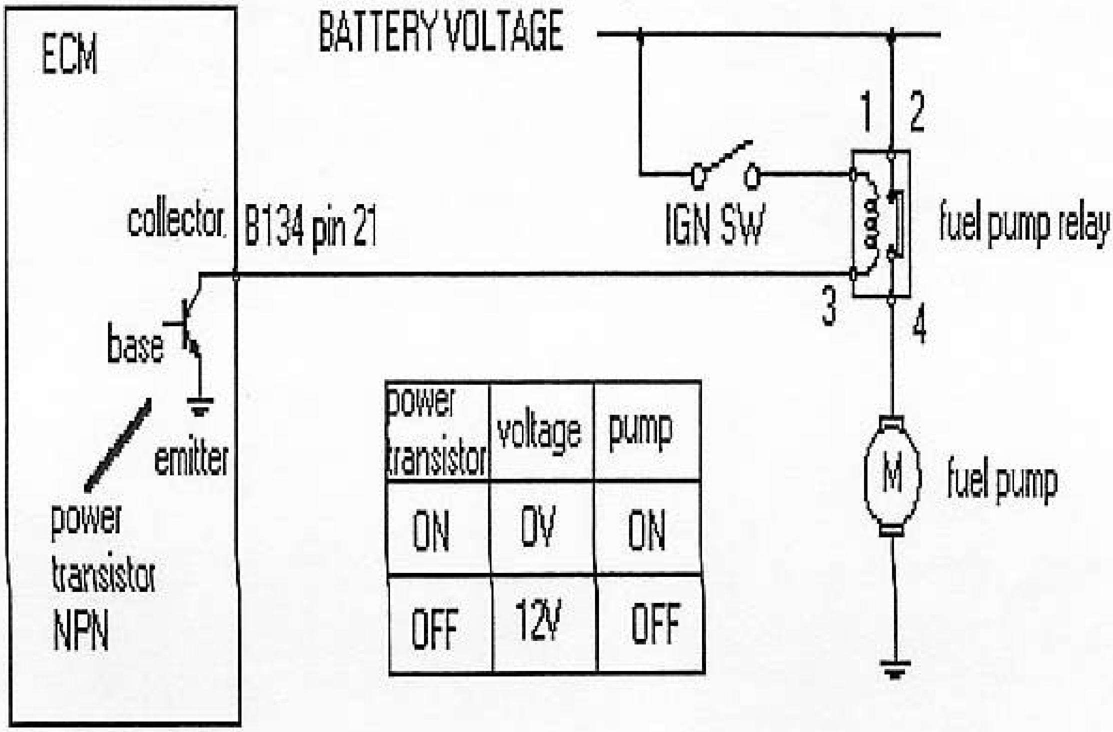
Multi-point fuel injection system
Basic normal injection pulse



WOT : Wide open throttle
PT1 : +600 mmhg/+80kPa
PT2 : +400 mmhg/+53kPa
PT3 : +200 mmhg/+27kPa
PT4 : 0 mmhg/ 0kPa
PT5 : -200 mmhg/-27kPa
PT6 : -400 mmhg/-53kPa

FUEL PUMP CIRCUIT.

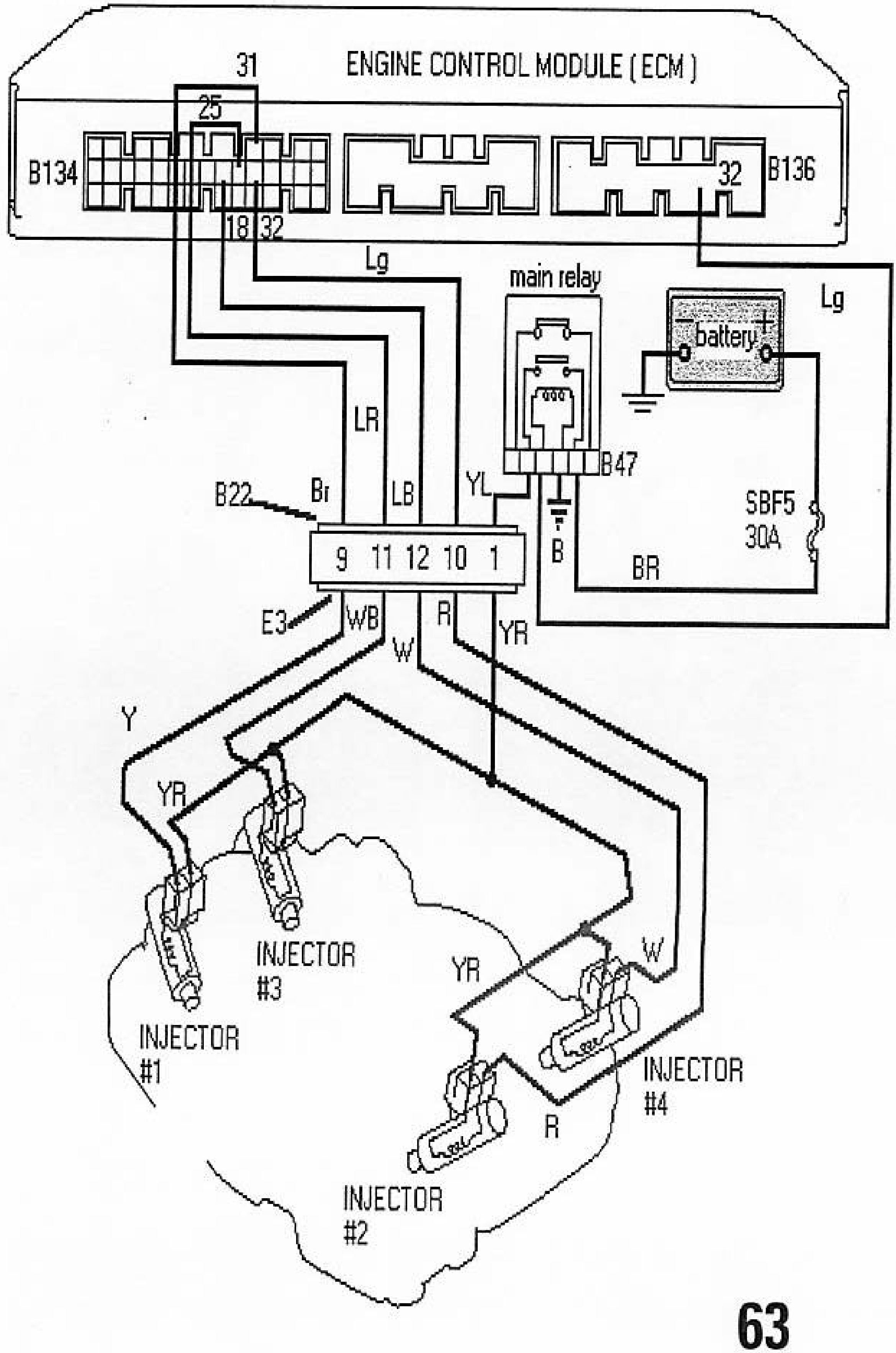


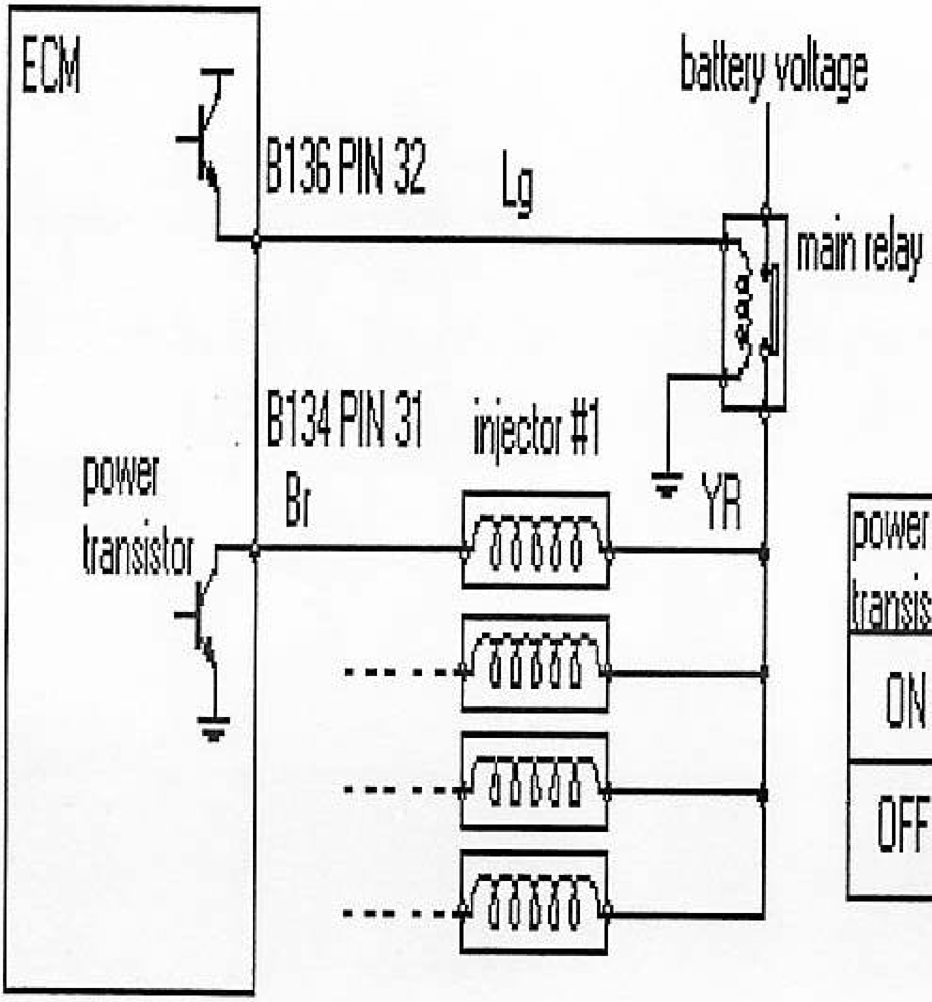


power transistor	voltage	pump
ON	0V	ON
OFF	12V	OFF

FUEL PUMP SCHEMATIC.

FUEL INJECTOR CIRCUIT DIAGRAM





power transistor	voltage	injector 1
ON	0V	ON
OFF	12V	OFF

FOUR GAS TEST P1

CO2	% vol	14.68
HC	ppm vol	11
O2	% vol	0.00
CO	% vol	0.003
COcor	% vol	0.00
Lambda		0.999
Engine speed 1/min		2455
Oil temperature °C		92

SUN MGA 1500

R1.00

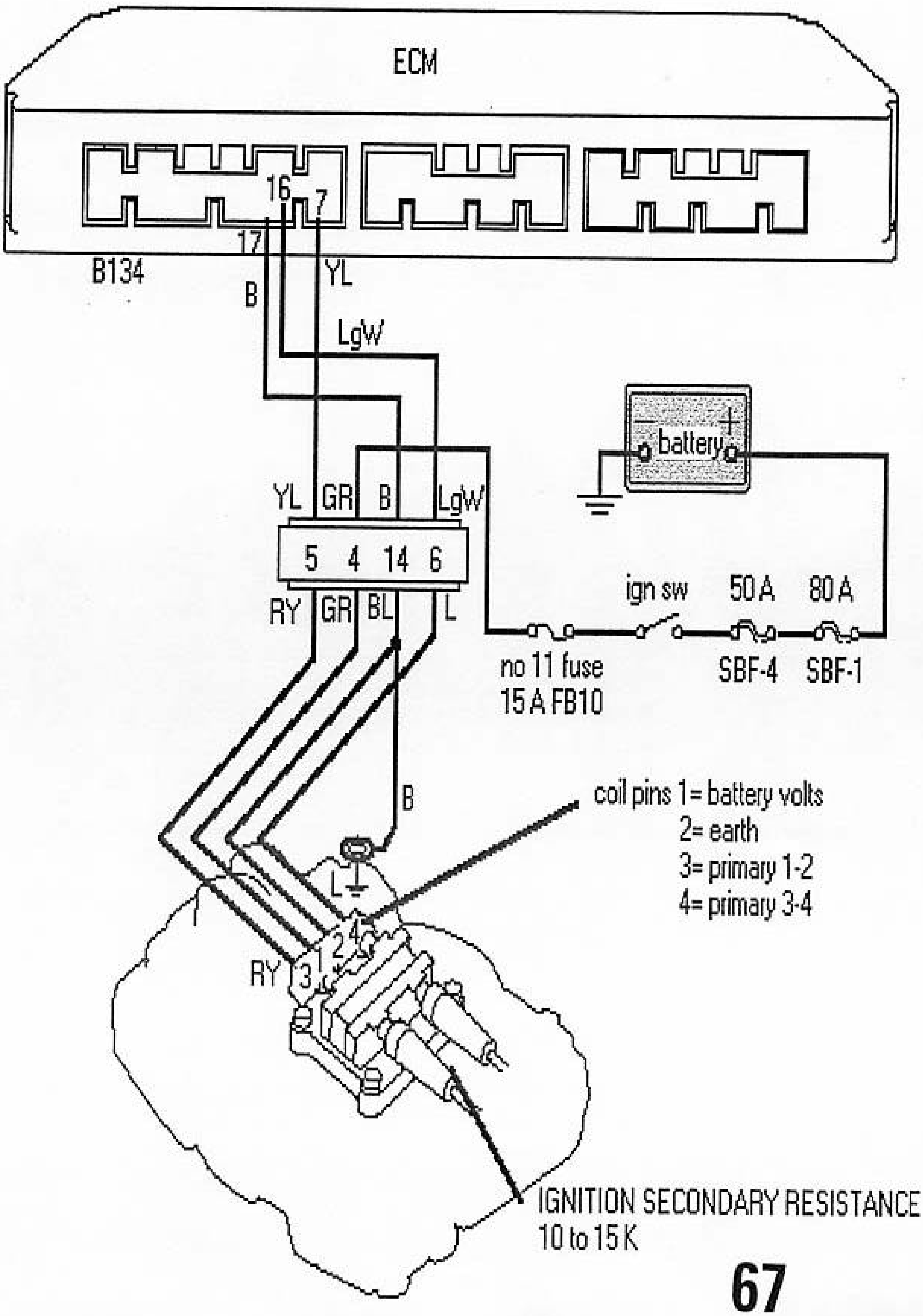
07-03-2000 15:16:16

CO2	% VOL	13% OR HIGHER
HC	ppmVOL	200ppm MAX
O2	% VOL	3% MAX
CO	% VOL	0.2% MAX
LAMBDA		0.97 to 1.03
OIL TEMP		MIN 80° C
ENGINE SPEED	IDLE	700 to 900 rpm
	FAST IDLE	2,400 to2,700 rpm

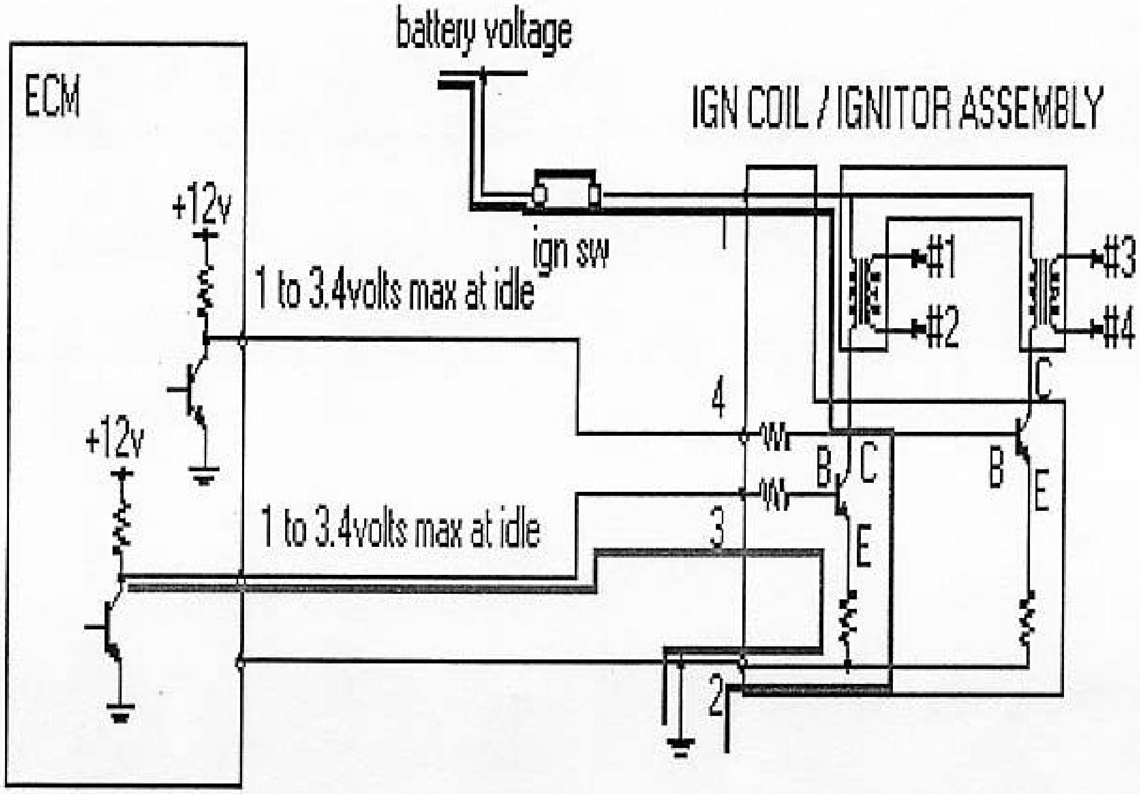
CO2	% VOL	13% OR HIGHER
HC	ppmVOL	200ppm MAX
O2	% VOL	3% MAX
CO	% VOL	0.2% MAX
LAMBDA		0.97 to 1.03
OIL TEMP		MIN 80° C
ENGINE SPEED	IDLE	700 to 900 rpm
	FAST IDLE	2,400 to2,700 rpm

CO2	% vol	13.73
HC	ppm vol	15
O2	% vol	0.31
CO	% vol	0.004
COcor	% vol	0.00
Lambda		1.015
Engine speed 1/min		726
Oil temperature °C		88

IGNITION CONTROL CIRCUIT.



IGNITOR OPERATION.

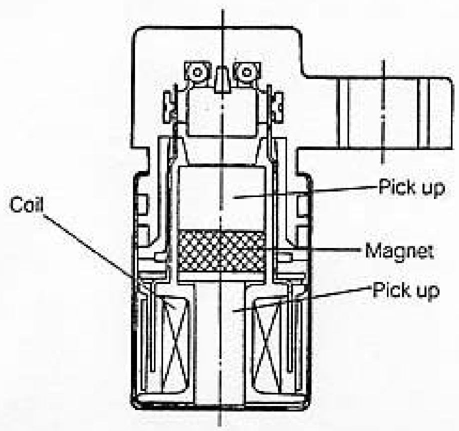


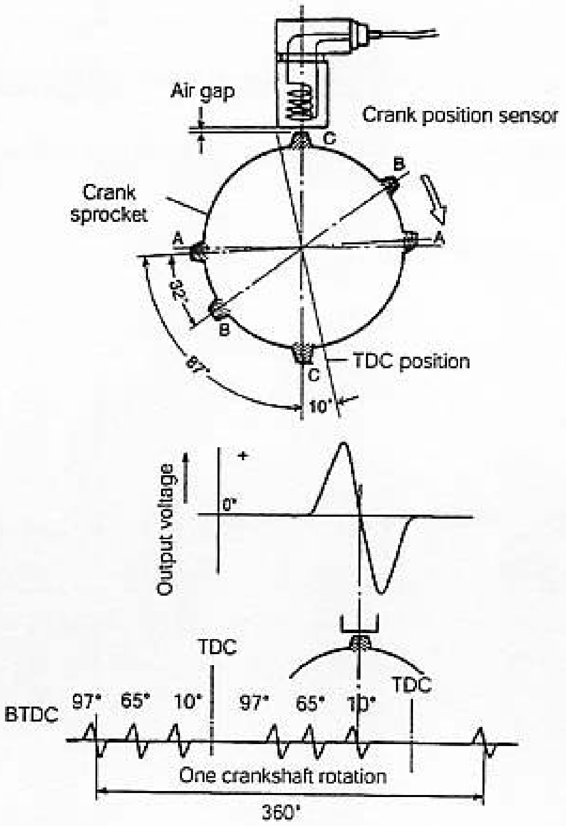
Crankshaft Position Sensor (Sequencial injection system)

The crankshaft position sensor detects the rotation angle of the crankshaft. This data is sent to the ECM which uses it as a basic signal for determining injection timing and ignition timing.
The signal generated by this sensor is output as AC voltage.

The crankshaft position sensor incorporates a coil, pick up, magnet, and insulator.

A crank sprocket that has six teeth rotates in synchronization with the crankshaft. This causes the teeth of the sprocket to pass in front of the crankshaft position sensor, which changes the air gap between the sprocket and the sensor. This in turn alters the magnetic flux density of the sensor's coil, generating an AC signal that provides an exact indication of the crankshaft angle.





Camshaft Position Sensor (Sequencial injection system)

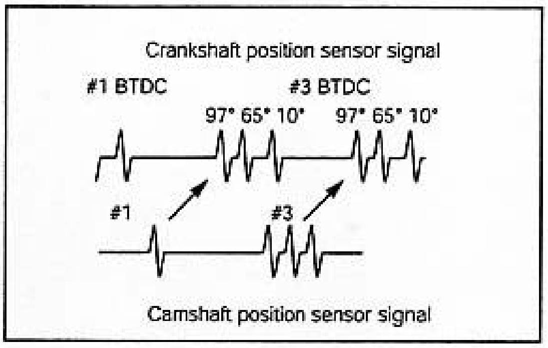
The camshaft position sensor detects the rotation angle of the camshaft. This data are sent to the ECM which uses it as a basis signal for determining injection timing and ignition timing. The signal generated by this sensor is output as AC voltage.

The camshaft position sensor incorporates a coil, pick up, magnet, and insulator.

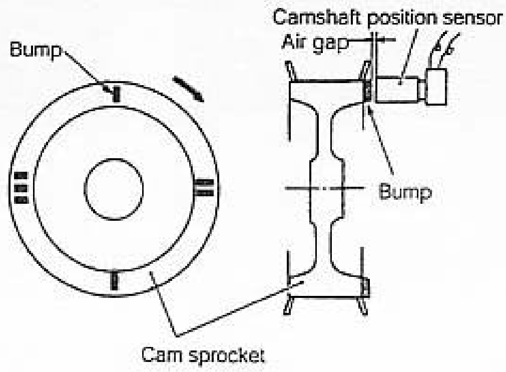
The internal construction of the sensor is identical with that of the crankshaft position sensor, but the camshaft position sensor is shielded in order to protect against the intrusion of electrical noise.

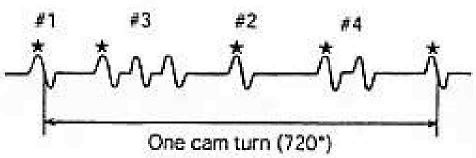
The camshaft position sensor detects the reference position of the crankshaft position as detected by the crankshaft position sensor.

A cam sprocket gear that has seven teeth rotates, which causes the bumps of the sprocket to pass in front of the camshaft position sensor and changes the air gap between the sprocket and the sensor. This in turn alters the magnetic flux density of the sensor's coil, generating an AC signal that is output as the crankshaft position reference. Combination of this signal and the crankshaft position sensor signal makes it possible to determine the crank angle and which cylinder is located before top dead center (BTDC) of compression stroke.

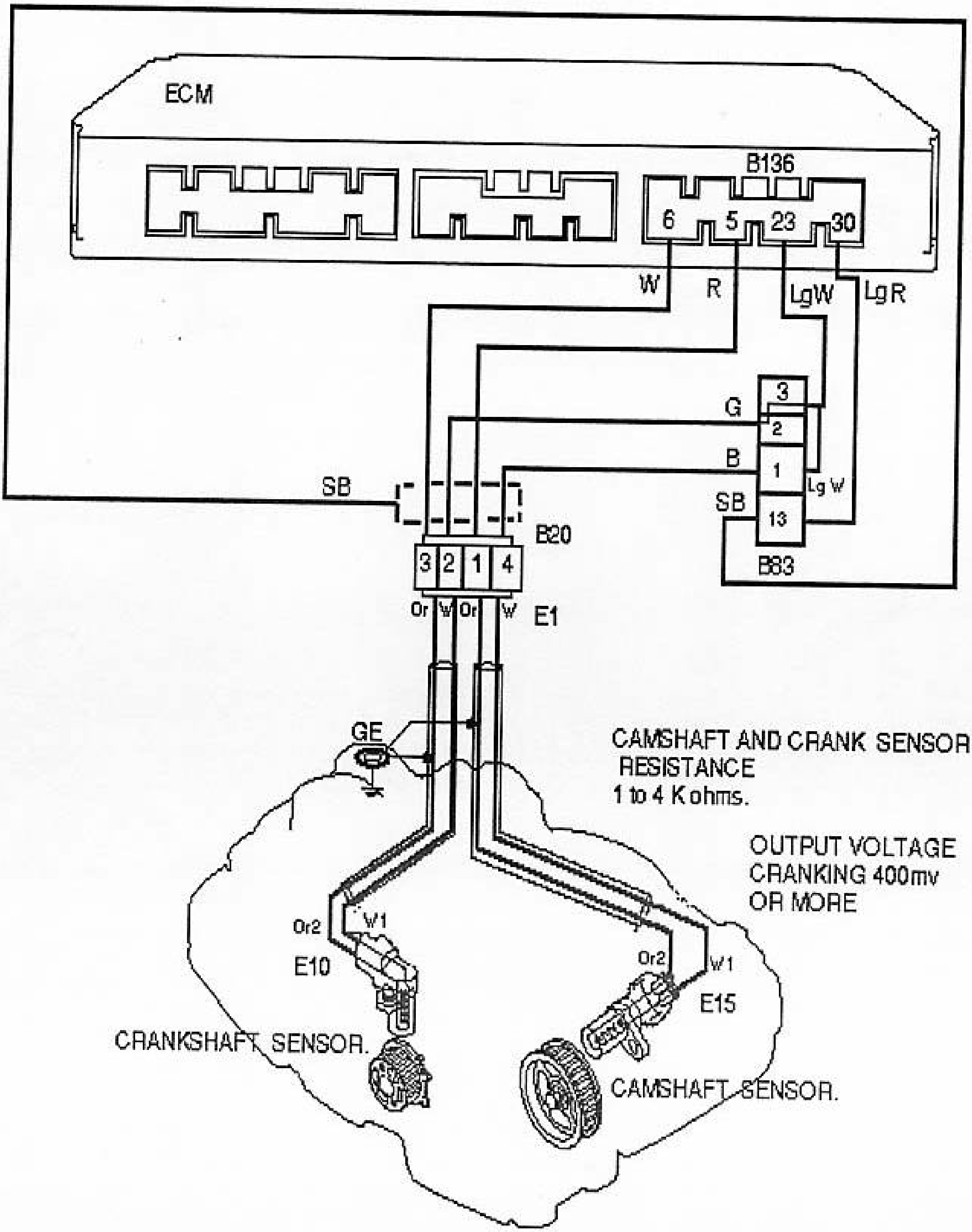


Relationship Between Crankshaft position Sensor Signal and Camshaft position Sensor Signal



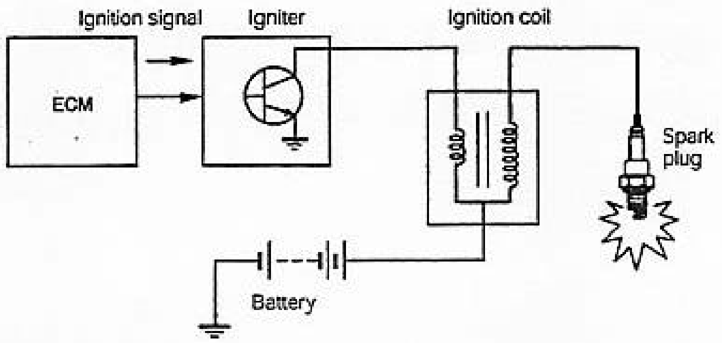


CRANKSHAFT AND CAMSHAFT POSITION SENSOR.



Ignition Circuit

The ignition circuit raises battery voltage to a range of 10,000 to 30,000 volts, which fires the spark plug and ignites the compressed air-fuel mixture in the combustion chamber. Even if a fine air-fuel mixture is created by controlling the fuel injection quantity precisely and is compressed completely, the engine will not be able to perform correctly if correct ignition is not provided.



Ignition Coil

The ignition coil raises battery voltage using electromagnetic induction. It consists of an soft iron core around which is wound with 20,000 to 30,000 turns of fine copper wire to form the secondary coil winding.
When current flowing through the primary coil winding is suddenly cut off, electromagnetic induction causes a very high voltage to be generated in the secondary coil winding.

Igniter

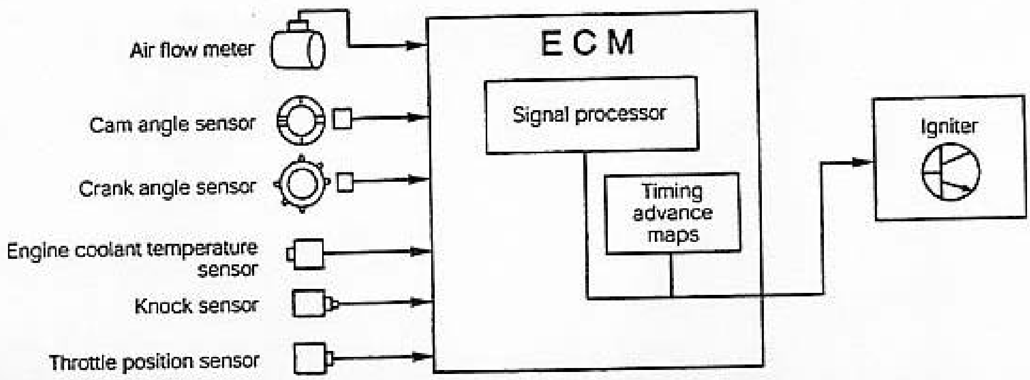
The igniter is the electronic part composed by transistors, resistors and some other electrical parts. It forms a contact-less point for turning ignition coil primary current on and off in accordance with signal from the ECM.

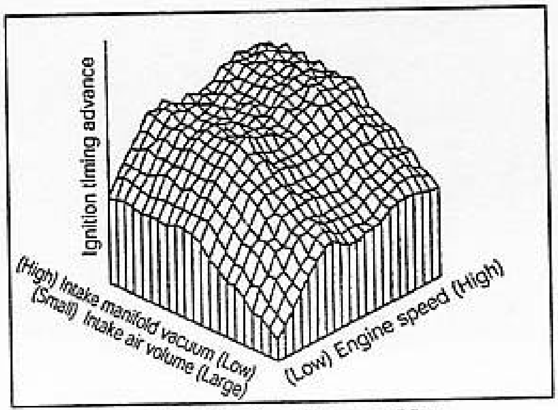
Basic Control Operation

Ignition timing control provides optimum ignition timing in accordance with engine speed and load.

The ECM analyzes input signals from the air flow sensor (or intake air pressure sensor), the crank angle sensor, the cam angle sensor, and the engine coolant temperature sensor to determine the engine speed and load, etc.

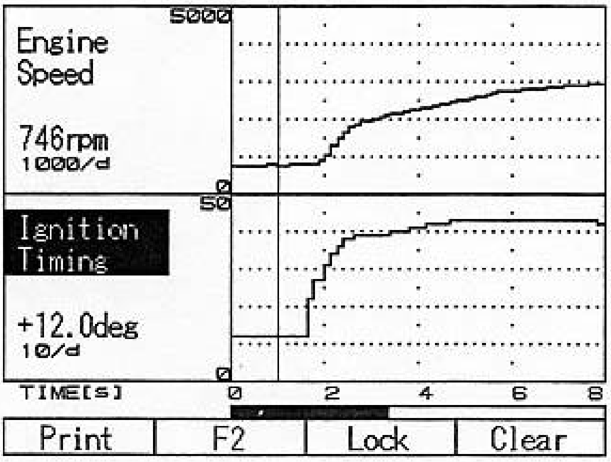
ECM memory contains optimum ignition timing advance data in accordance with intake manifold vacuum and engine speed. The ECM periodically locates the timing advance values in the map that corresponds to engine operation conditions, evaluates the octane level of the gasoline based on signals from the knock sensor, and relearns conditions that change as the engine ages in order to determine ignition timing.

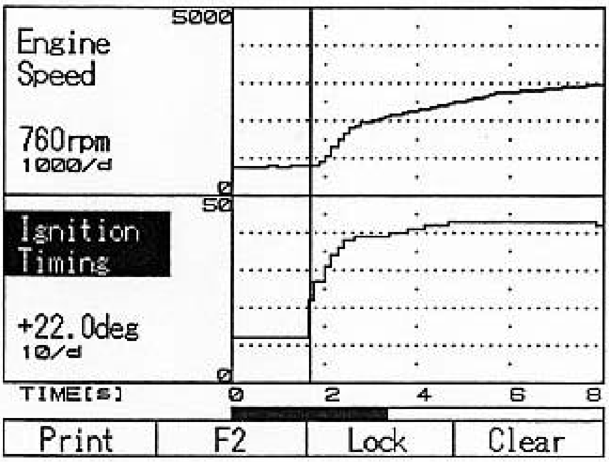


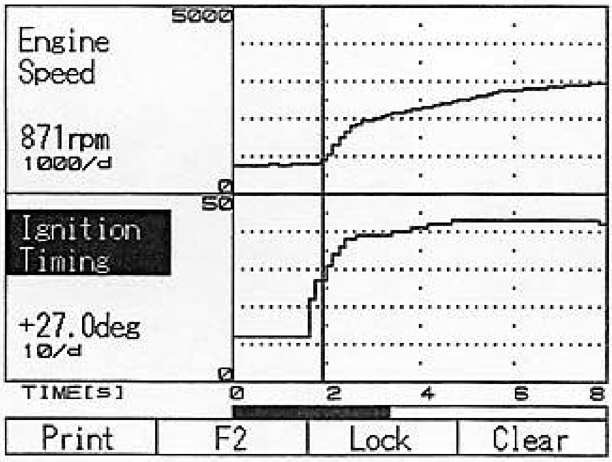


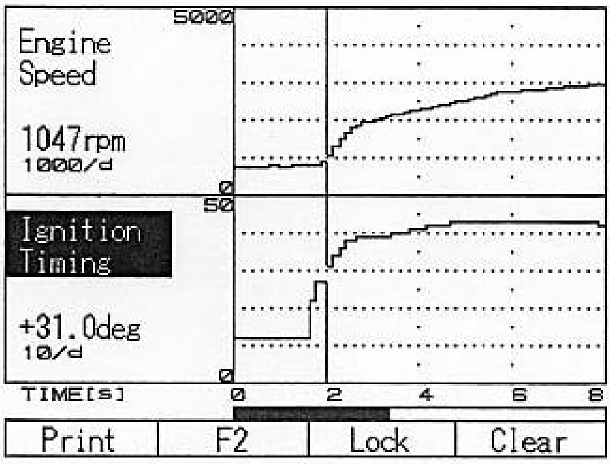
Ignition timing Advance Map

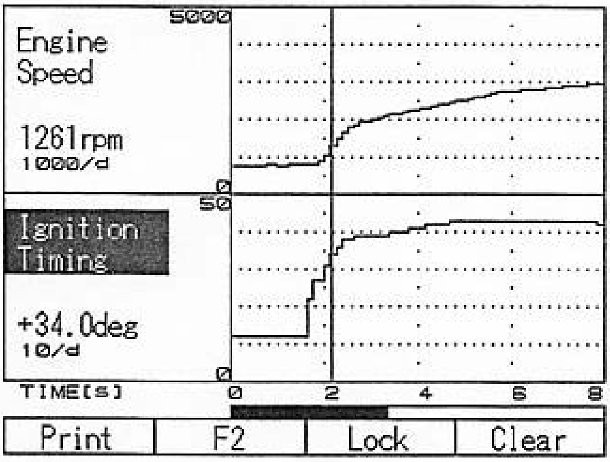
SUBARU IMPREZA P1 IGNITION ADVANCE DATA, NO LOAD VEHICLE STATIC.

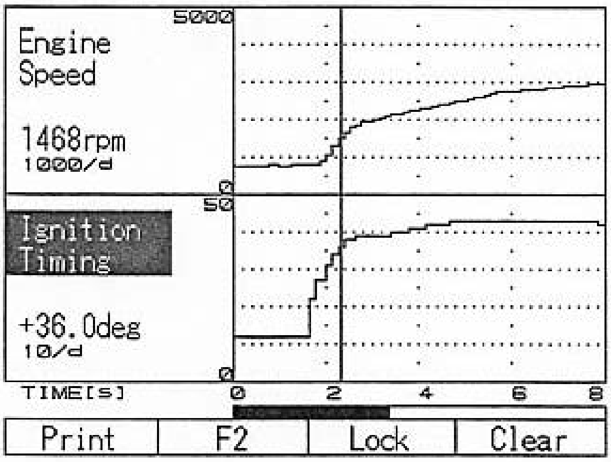


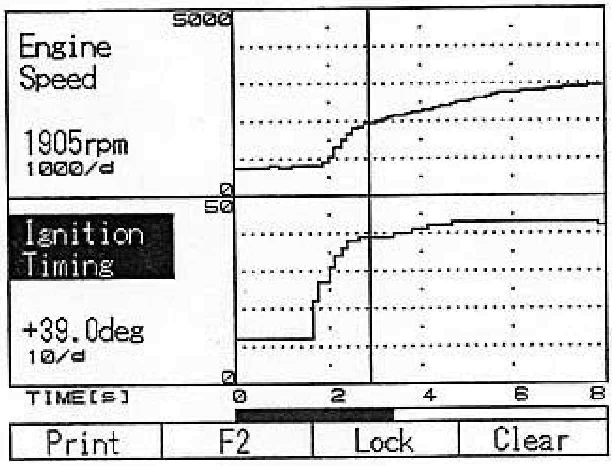


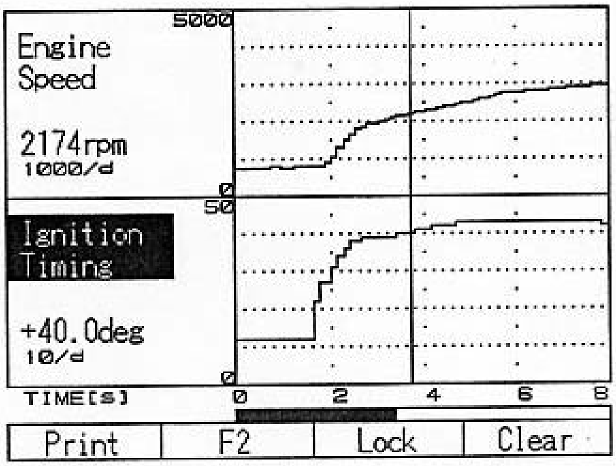


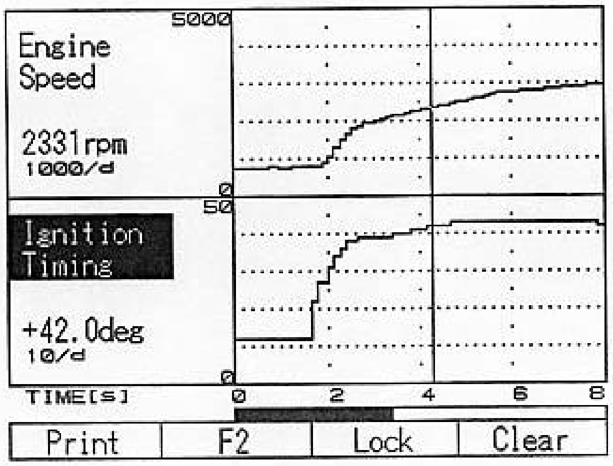


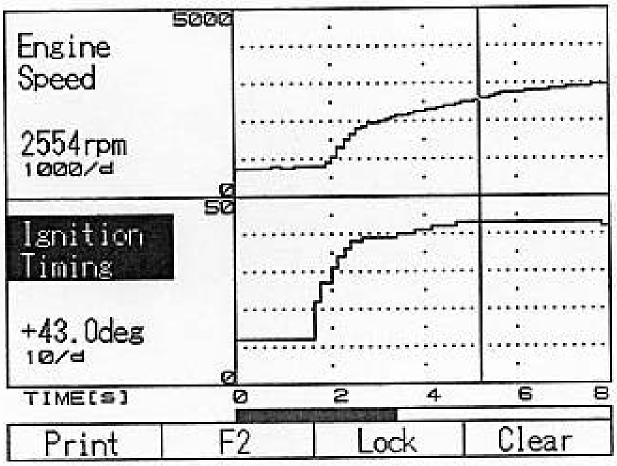


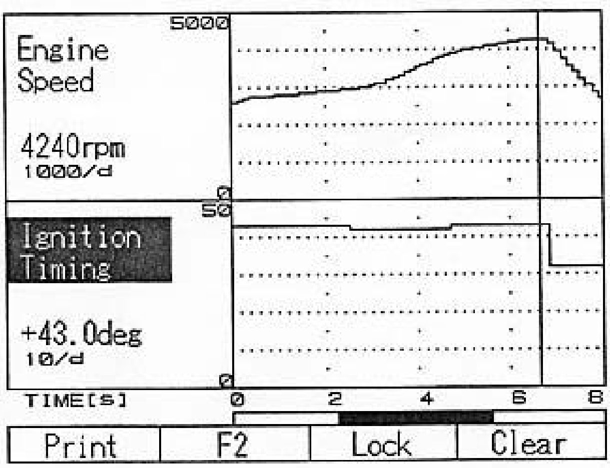


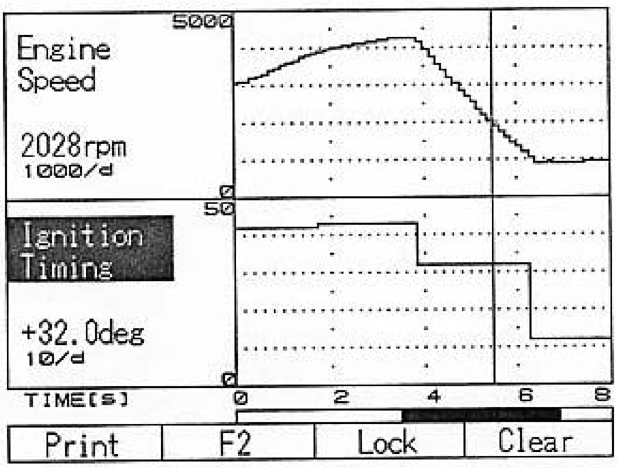

Engine Speed
1905rpm
1000/d
5000
0
Ignition Timing
+39.0deg
10/d
50
0
TIME[S]
0 2 4 6 8
Print
F2
Lock
Clear


Engine Speed
2174rpm
1000/d
5000
0
Ignition Timing
+40.0deg
10/d
50
0
TIME[S]
0 2 4 6 8
Print
F2
Lock
Clear


Engine Speed
2331rpm
1000/d
5000
0
Ignition Timing
+42.0deg
10/d
50
0
TIME[S]
0 2 4 6 8
Print
F2
Lock
Clear

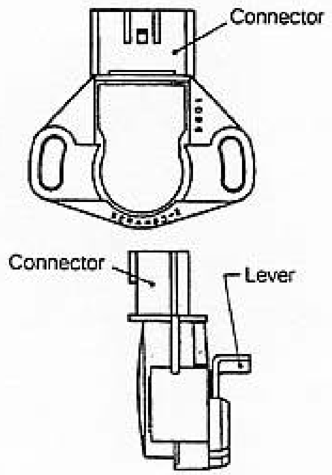

Engine Speed
2554rpm
1000/d
5000
0
Ignition Timing
+43.0deg
10/d
50
0
TIME[S]
0 2 4 6 8
Print
F2
Lock
Clear


Engine Speed
4240rpm
1000/d
5000
0
Ignition Timing
+43.0deg
10/d
50
0
TIME[S]
0 2 4 6 8
Print
F2
Lock
Clear

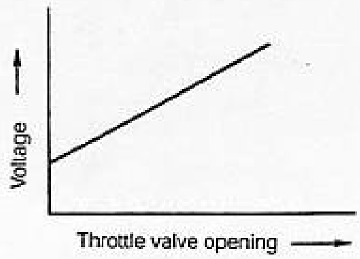

Engine Speed
2028rpm
1000/d
5000
0
Ignition Timing
+32.0deg
10/d
50
0
TIME[S]
0 2 4 6 8
Print
F2
Lock
Clear

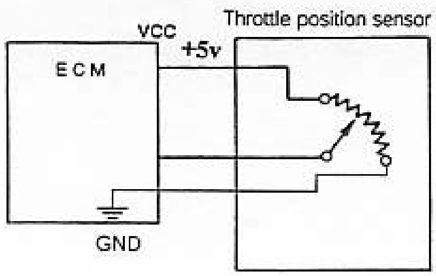
Throttle Position Sensor

The throttle position sensor is located inside the throttle body. The throttle position sensor converts the driver-controlled throttle valve status to a voltage and sends it to the ECM.



Movement of the throttle shaft causes a slider to rotate, which changes the contact position of a variable resistor and output of the throttle valve opening as potentiometer voltage change.



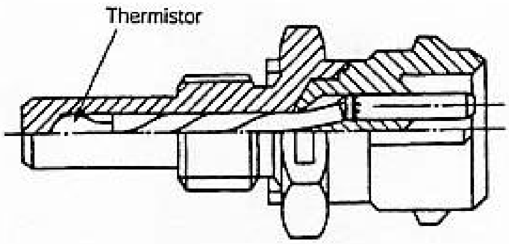


FULLY CLOSED: 0.2 to 0.8 VOLT STD 0.5 VOLT

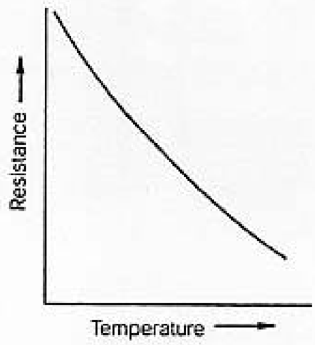
FULLY OPEN: 4 to 4.6 VOLTS.

Engine Coolant Temperature Sensor

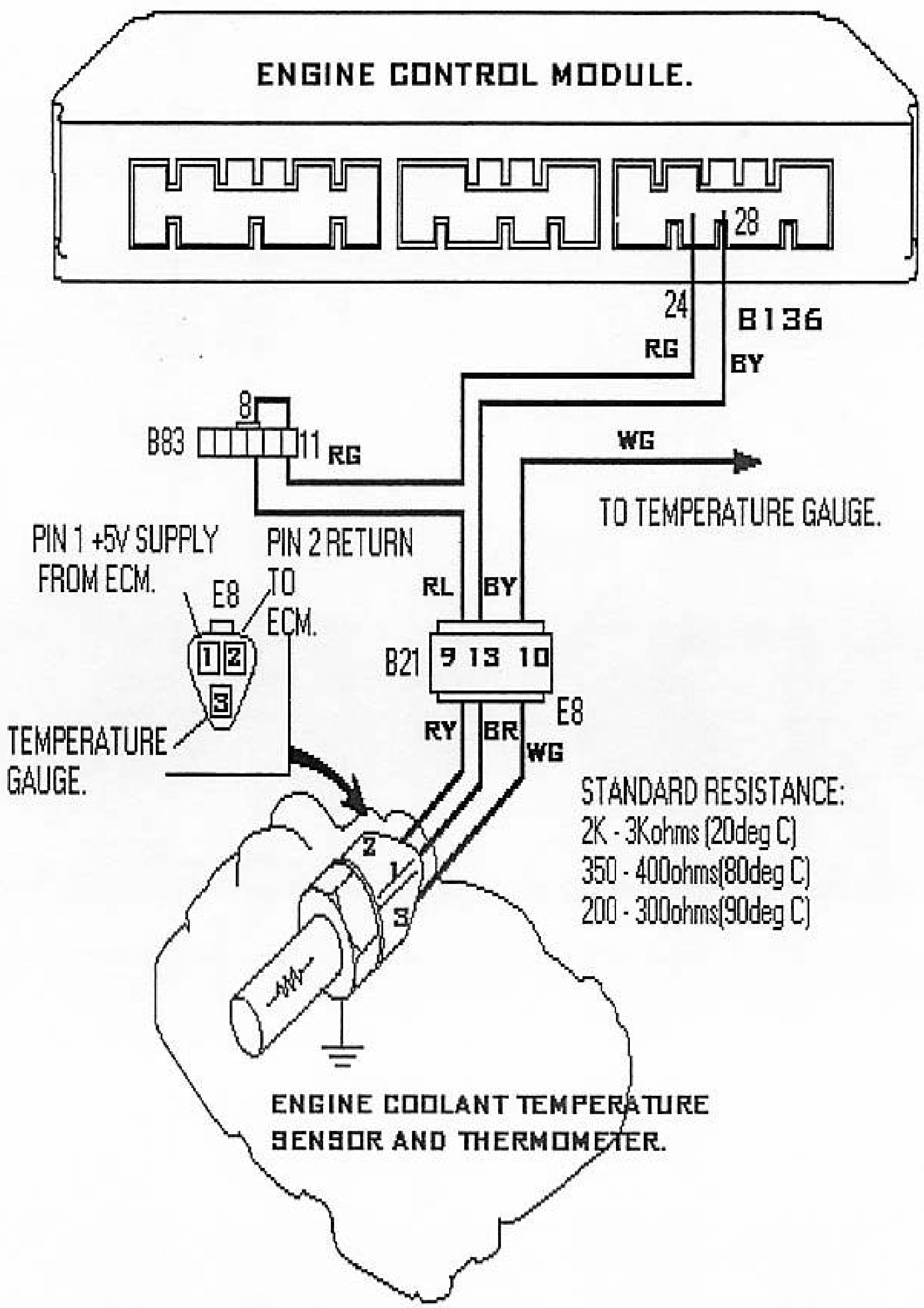
The engine coolant temperature sensor is located in the coolant passage. The sensor contains a thermistor that detects the temperature of the engine coolant.



The engine coolant temperature sensor detects changes in the resistance of a thermistor and sends a corresponding voltage signal to the ECM. This signal provides important basic information that is used for injection, ignition, idle speed, and other controls.



ENGINE COOLANT TEMPERATURE SENSOR



Subaru Impreza P1 – Driving Light Wiring Modification

Switch Wiring

2 Black Illum. Lamp Neg.			1 Violet 12v pos. on/off indicator
6 Not Used	5 Black Neg. input for Output at pin 3	4 Violet 12v pos. Illum.lamp	3 Yellow/White Switched neg. o/p to relay.

Fog lamp switch – 83001FA131 required.

Following modifications required to switch –

1. Fit blue filter to on/off indicator lamp.
2. Remove plug restrictor at rear of switch.
3. Fit new 'driving lamp' sticker over existing icon.

Standard Wiring (driving lights operate during side/dipped & main beam)

Pin:	Wire colour:	Function:
1	Violet	On/off indicator lamp - 12v pos.(side/dip/main).
2	Black	Illumination lamp – neg.
3	Yellow/White	Switched output (neg.) to driving lamp relay (pin 1).
4	Violet	Illumination lamp - 12v pos. (side/dip/main).
5	Black	Neg. input – for switched output at yellow/white.
6	Not used	Not used.

Rewiring Instructions (driving lights to operate only during main beam)

Pin:	Wire colour:	Function:
1	**Violet**	**Cut wire. Insulate vehicle side. Supply new feed to switch side from Yellow /Blue (8 way white & black plug behind fuse-box). Headlight main beam 12v pos.**
2	Black	As standard wiring.
3	Yellow/White	As standard wiring.
4	**Violet**	**Cut and insulate both ends – not required.**
5	Black	As standard wiring.
6	Not used	Not used

P1DLR Issue 2
Approval pending -

Prepared by M.Smith

Subaru Impreza P1 – Driving Light Wiring Modification

Relay Wiring

3 White/Red Switch O/P	4 Red/Blue Switch I/P
1 Black/Yellow Coil Neg.	2 Violet Coil Pos.

22 Amp relay (82501GA240) required.
Relay mounting clip (81910AA150) required.

Standard Wiring (driving lights operate during side/dipped & main beam)

Pin:	Wire colour:	Function:
1	Black/Yellow	To relay coil - Switched neg. from driving light switch.
2	Violet	To relay coil – 12v pos. (side/dip/main).
3	White/Red	Pos. 12v output from relay. (To driving lights)
4	Red/Blue	Pos. 12v (+30) input to relay.

Rewiring Instructions (driving lights to operate only during main beam)

Pin:	Wire colour:	Function:
1	Black/Yellow	As standard wiring
2	**Violet**	**Cut wire. Insulate vehicle side. Supply new feed to relay side from Yellow/Blue (8 way white & black plug behind fuse-box). Headlight main beam 12v pos.**
3	White/Red	As standard wiring
4	Red/Blue	As standard wiring

P1DLR Issue 2
Approval pending -

Prepared by M.Smith