Diagnosis – Cylinder Analysis

Cylinder Analysis

This test is comprised of the following:

- Compression (dynamic)
- Ignition system

⚠ Due to the complexity of the fuel injection system on HFM-SFI engines, only the compression test is meaningful.

Compression (dynamic)

General Information

The compression test is performed over the starter current draw. The decompression cycle is measured to indicate the mechanical condition of the engine. This data will provide indirect information about engine timing, frictional horsepower and compression via data tables and scope patterns.

Prerequisite:

- Engine: **OFF**
- Attach current clamps to battery negative (B–) terminal (on model 129, ground connection between transmission and chassis [accessible from underneath only] on right hand side; on model 140/202, left hand side).
- Wait for additional instructions to appear.
- Start engine.
- Engine at idle until further instructions.
- Display: *Print display or diagram*

Diagnosis – Cylinder Analysis

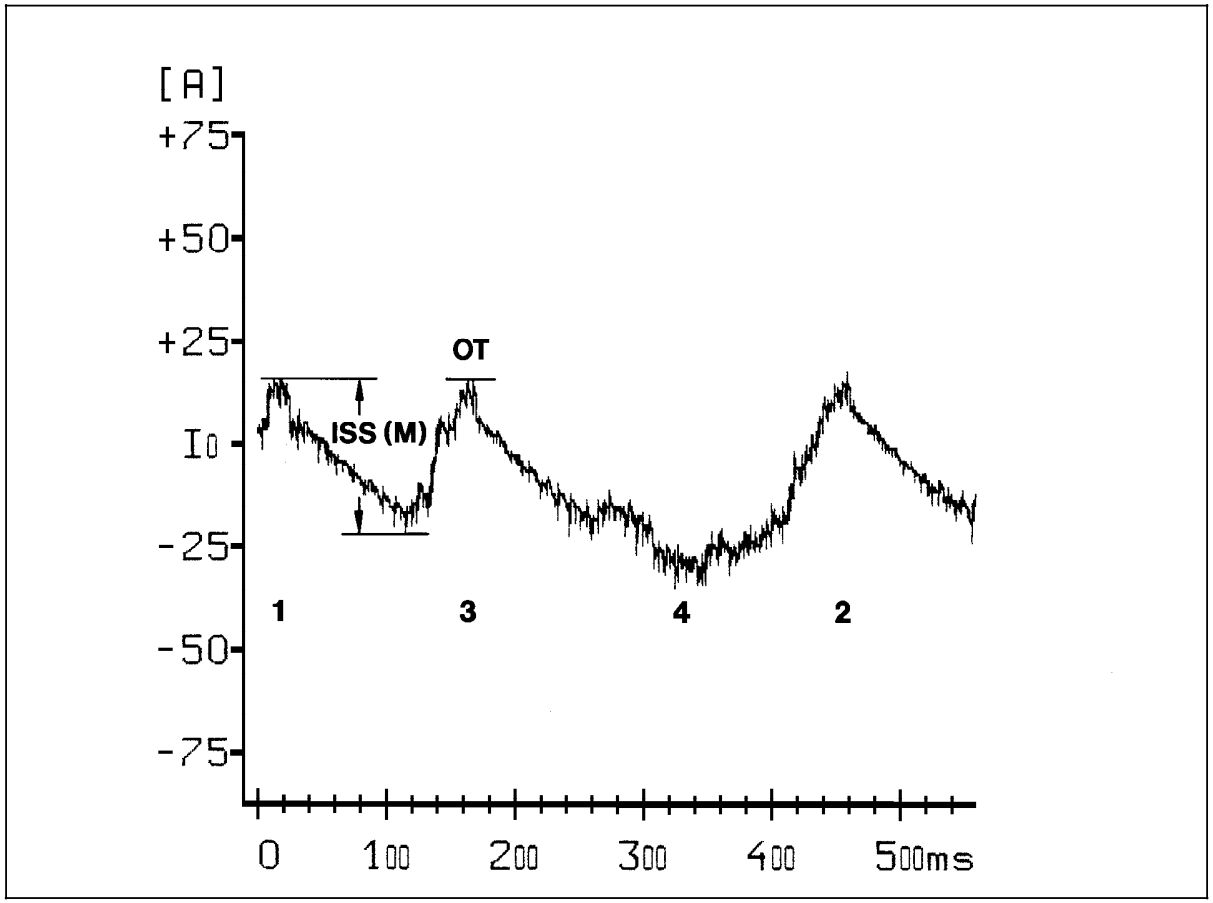
Compression (dynamic)

General information

Bad scope pattern

Starter speed	250 rpm
Current	31 A
Engine oil temperature	80 °C

OT	Top dead center (TDC)
Cylinder 4	Cylinder with low starter current (bad compression)
ISS	Starter current in Ampere
M	Measurement value
ms	Time in milliseconds



P15-0378-57

Figure 1

Diagnosis – Cylinder Analysis

Compression (dynamic)

a) 4–cylinder engine, Engine 102/111

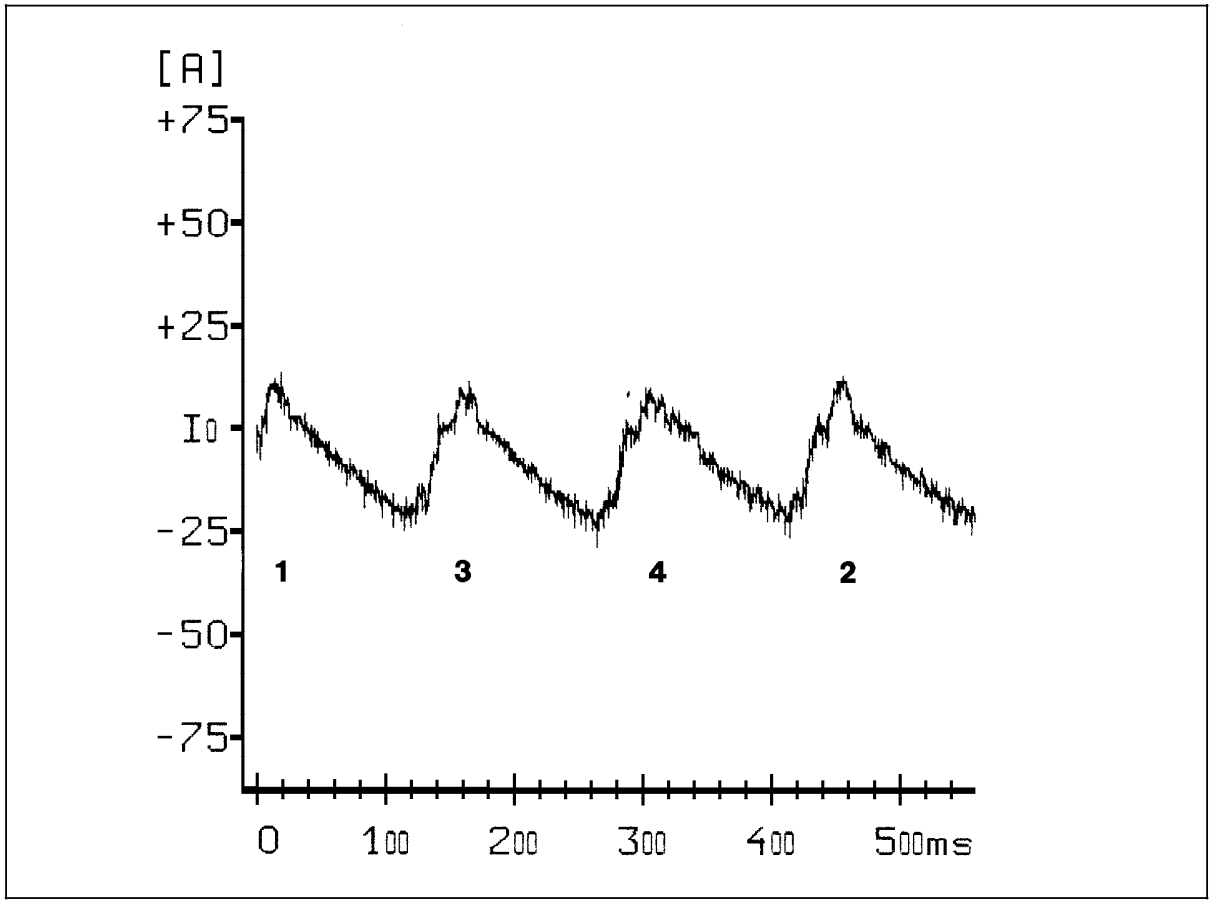
Cylinder	Engine speed/cylinder rpm	ISS (A)	Engine speed rpm	Temperature °C
Ref.			221	35
1	193	57		
3	244	65		
4	196	55		
2	251	63		
Minimum	193	55		
Maximum	251	65		
Difference	58	10		

The largest and smallest cylinder values, as well as the difference of these values, are given when printing the current table.
This will make the evaluation of the magnitude of the failure easier.
The value listed under difference can be used to determine if a mechanical failure is present, for example: difference of ISS > 4A on 4-cylinder engines means that there is possibly a mechanical failure present.
See section A for Test and adjustment data.

Diagnosis – Cylinder Analysis

Compression (dynamic)

Compression scope pattern, Engine 102/111
Good scope pattern.
The relation of the curve to the cylinders is determined by the entered firing sequence 1 – 3 – 4 – 2, starting with cylinder 1.



P15-0363-57

Figure 2

Diagnosis – Cylinder Analysis

Compression (dynamic)

b) 6–cylinder engine, Engine 103, 104

The relation of the curve to the cylinders is determined by the entered firing sequence 1 – 5 – 3 – 6 – 2 – 4, starting with cylinder 1.

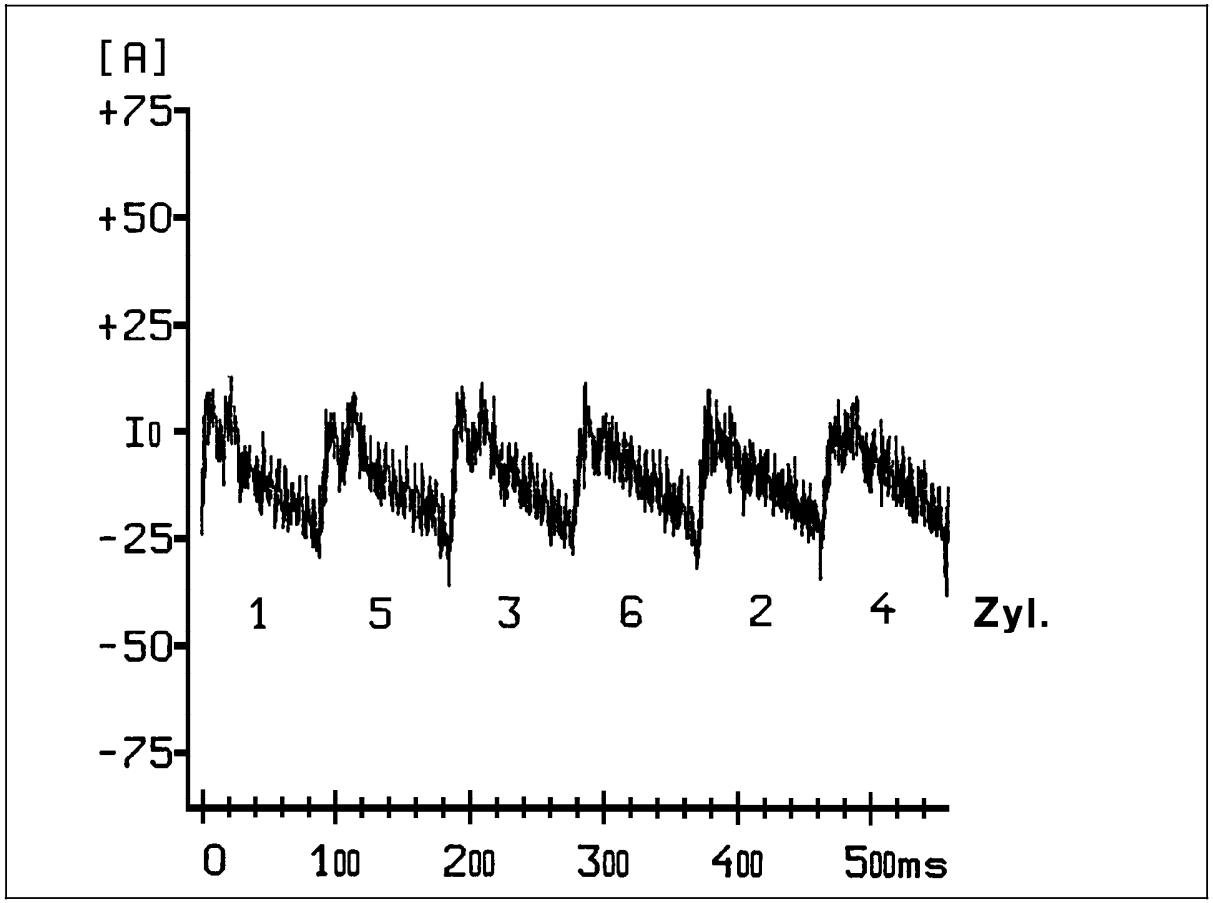
Cylinder	Engine speed/cylinder rpm	Iss (A)	Engine speed rpm	Temperature °C
Ref.			250	35
1	249	27		
5	248	29		
3	249	31		
6	250	30		
2	250	30		
4	250	30		
Minimum	248	27		
Maximum	250	31		
Difference	2	4		

See section A for Test and adjustment data.

Diagnosis – Cylinder Analysis

Compression (dynamic)

Compression scope pattern, Engine 103,104
Good scope pattern.



P15-0093-57A

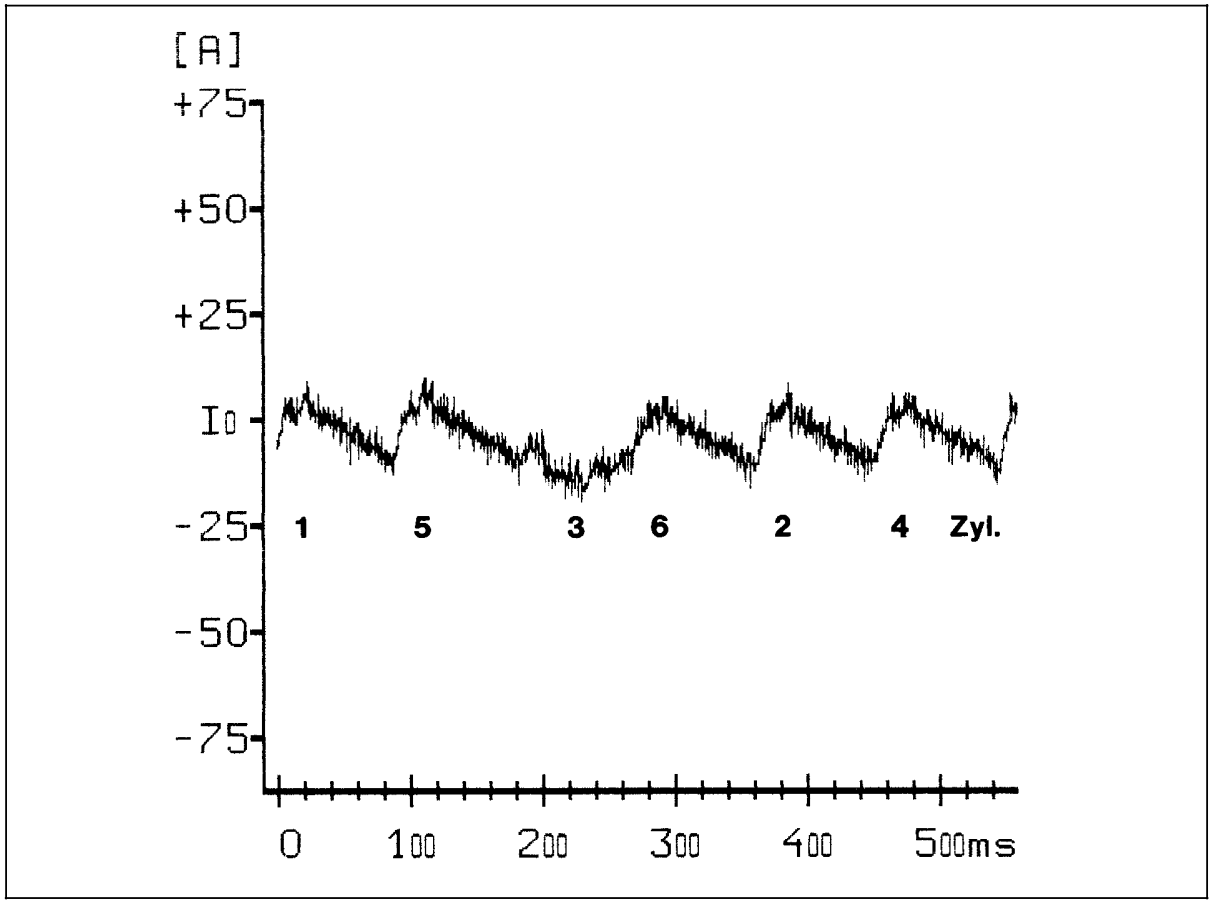
Figure 3

Diagnosis – Cylinder Analysis

Compression (dynamic)

6–cylinder engine scope pattern, Engine 103, 104
Bad scope pattern.
Low starter current on cylinder 3, bad compression.

Starter speed	250 rpm
Current	31 A
Engine oil temperature	80 °C



P07-0409-57

Figure 4

Diagnosis – Cylinder Analysis

Compression (dynamic)

e) 8–cylinder engine, Engine 116, 117

Cylinder	Engine speed/cylinder rpm	Iss (A)	Engine speed rpm	Temperature °C
Ref.			190	35
1	190	60		
5	191	59		
4	189	60		
8	189	61		
6	189	59		
3	191	62		
7	191	59		
2	189	60		
Minimum	189	59		
Maximum	191	62		
Difference	2	3		

See section A for Test and adjustment data.

Diagnosis – Cylinder Analysis

Compression (dynamic)

On 8–cylinder engines, the average current value between the cylinder banks is compared and the difference shown. This allows identification of engine timing failures.

	left cylinder bank	Iss (A)	right cylinder bank	Iss (A)
	5	59	1	60
	8	61	4	60
	6	59	3	62
	7	59	2	60
Total		238		242
Minimum		59		60
Difference				

See section A for Test and adjustment data.

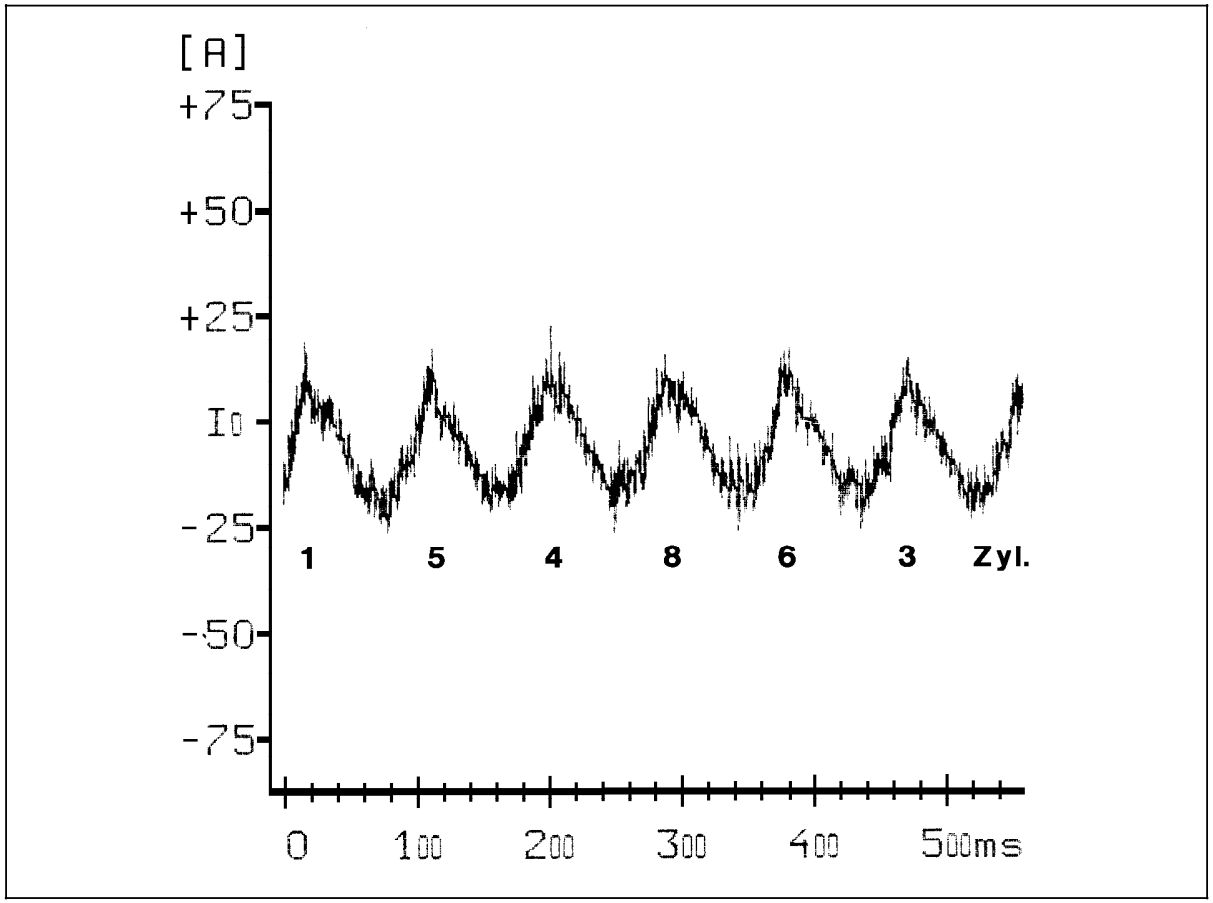
Diagnosis – Cylinder Analysis

Compression (dynamic)

8–cylinder engine scope pattern, Engine 116, 117
Good scope pattern.
The relation of the curve to the cylinders is determined by the entered firing sequence 1–5–4–8–6–3–7–2, starting with cylinder 1.

Starter speed	191 rpm
Current	62 A
Engine oil temperature	80 °C

On 8–cylinder engines, the scope pattern is continued on the following page of the engine analyzer with cylinders 7 and 2.



P07-0408-57

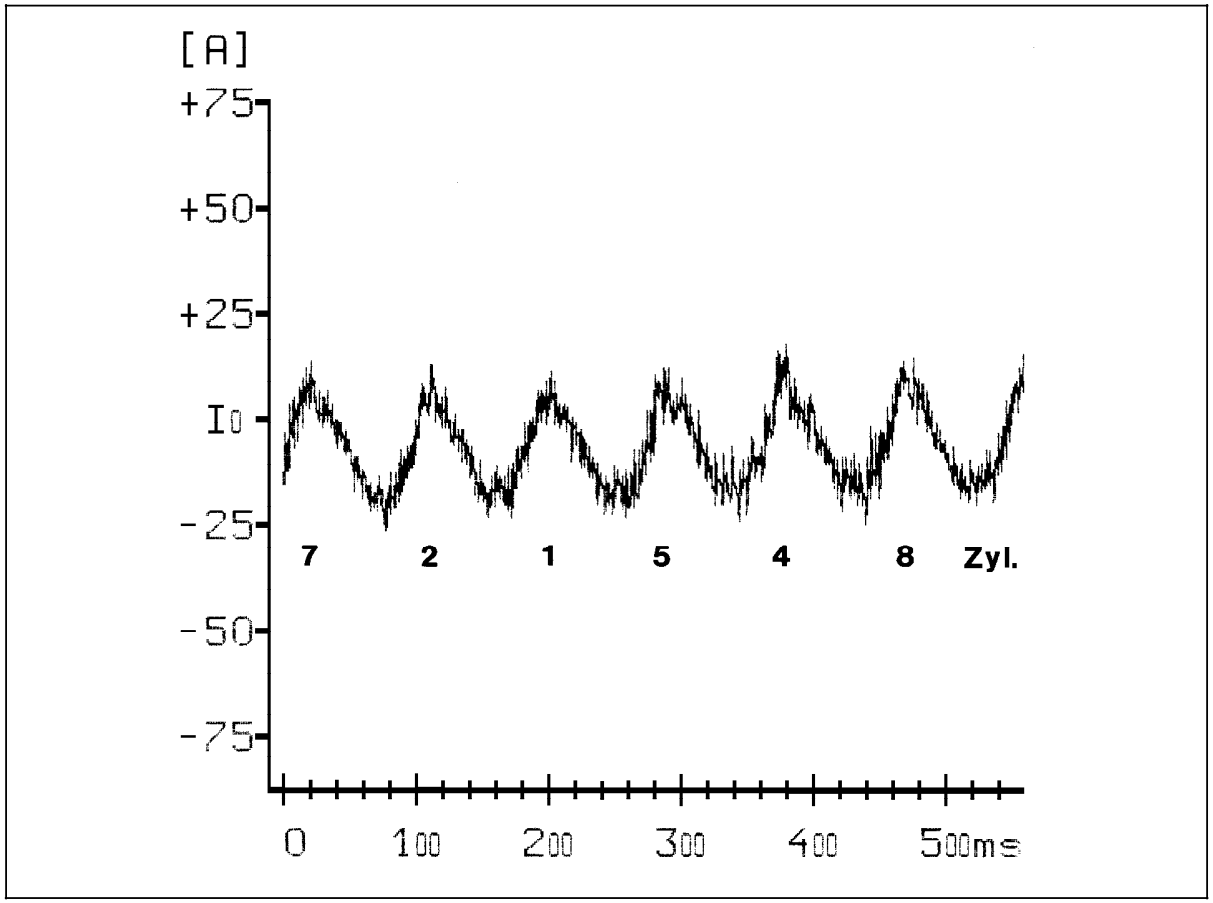
Figure 5

Diagnosis – Cylinder Analysis

Compression (dynamic)

8–cylinder engine scope pattern, Engine 116, 117
Good scope pattern.
Continuation of scope pattern on second page.

Starter speed	191 rpm
Current	62 A
Engine oil temperature	80 °C



P07-0407-57

Figure 6

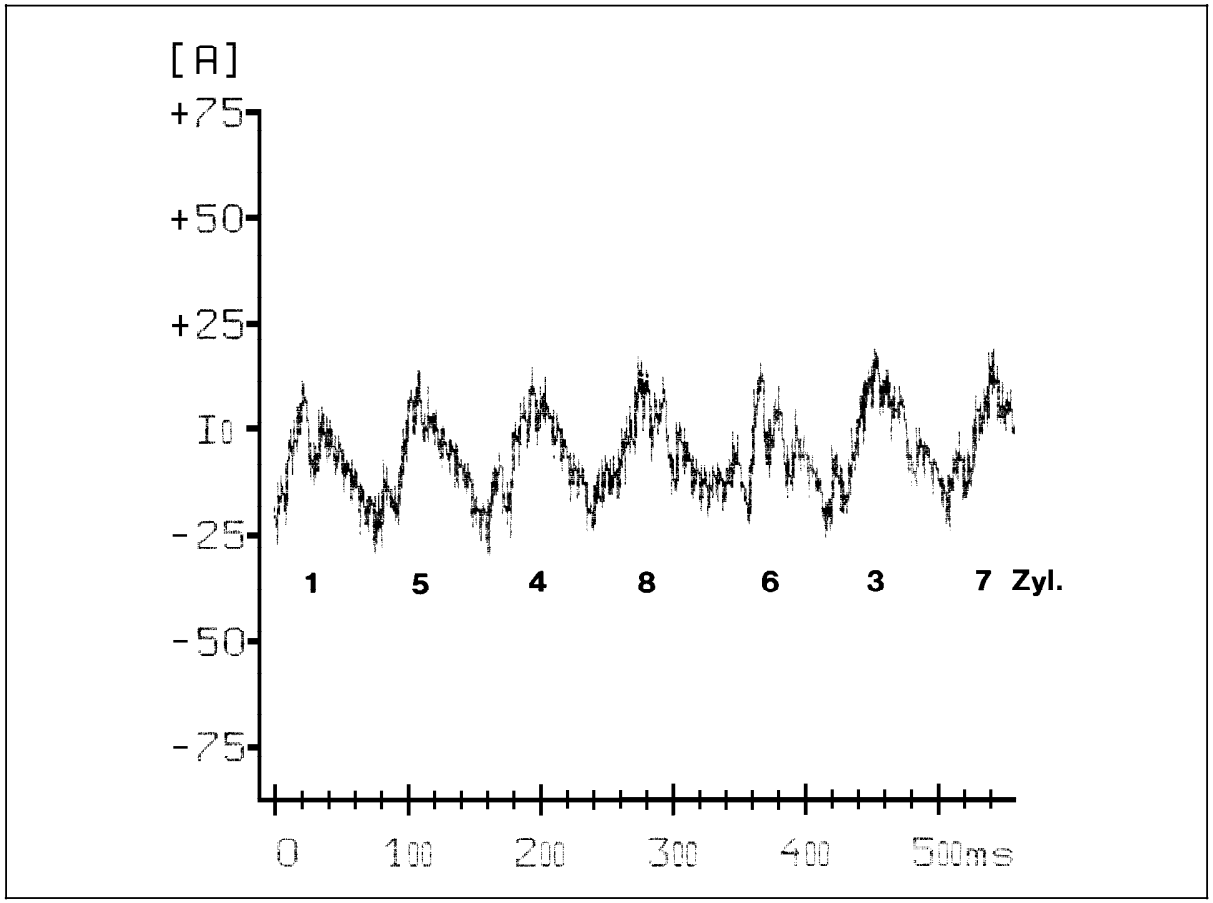
Diagnosis – Cylinder Analysis

Compression (dynamic)

8–cylinder engine scope pattern, Engine 116, 117
Bad scope pattern.
Low starter current on cylinder 2, bad compression.

Starter speed	191 rpm
Current	62 A
Engine oil temperature	80 °C

On 8–cylinder engines, the scope pattern is continued on the following page of the engine analyzer.



P15-0248-57

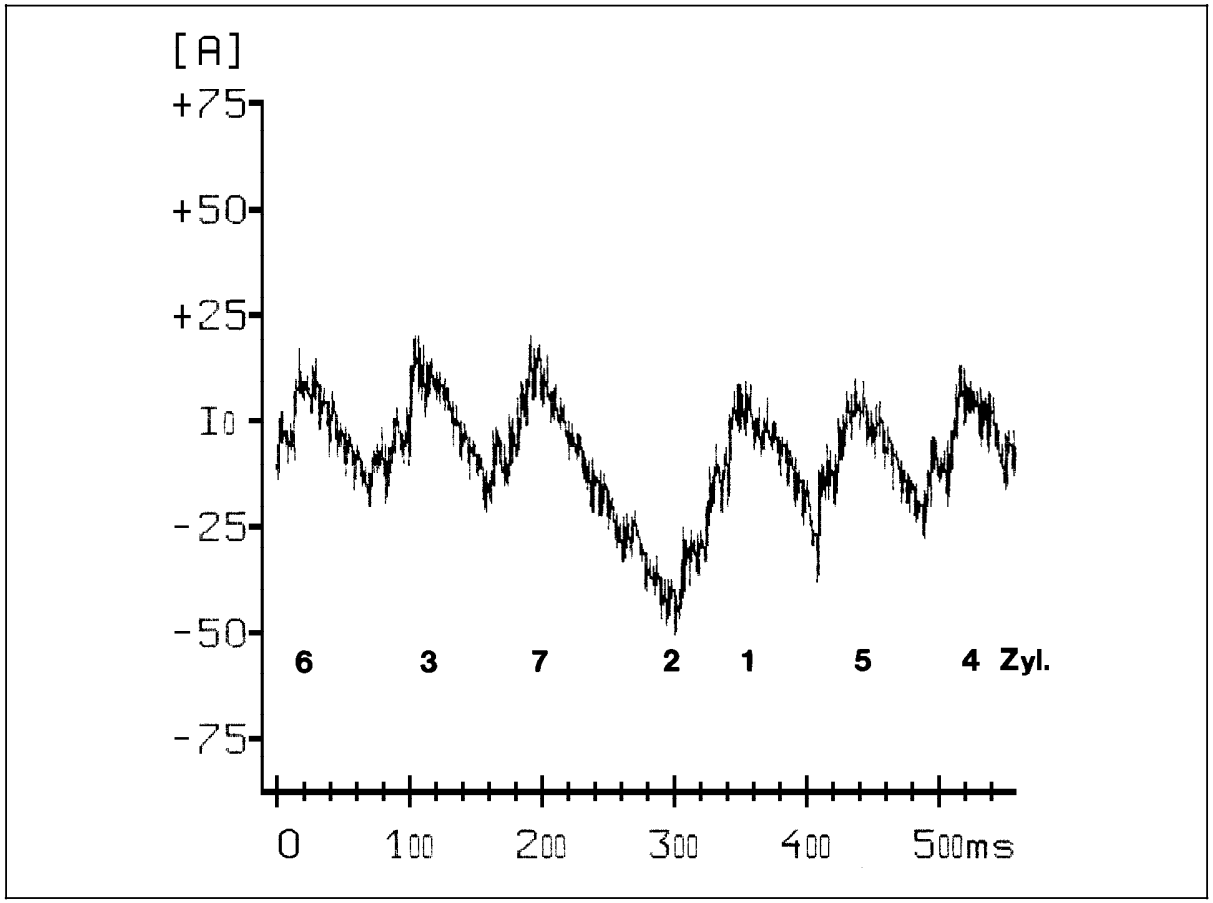
Figure 7

Diagnosis – Cylinder Analysis

Compression (dynamic)

8–cylinder engine scope pattern, Engine 116, 117
Bad scope pattern.
Continuation of scope pattern on second page.

Starter speed	191 rpm
Current	62 A
Engine oil temperature	80 °C



P15-0249-57

Figure 8

Diagnosis – Cylinder Analysis

Compression (dynamic)

On 12–cylinder engines, the average current value between the cylinder banks is compared and the difference shown. This allows identification of engine timing failures.

	left cylinder bank	Iss (A)	right cylinder bank	Iss (A)
	12	26	1	28
	8	23	5	29
	10	27	3	22
	6	26	7	27
	2	25	11	26
	4	26	9	26
Total		153		158
Minimum		25		26
Difference				

See section A for Test and adjustment data.

Diagnosis – Cylinder Analysis

Compression (dynamic)

e) 12–cylinder engine, Engine 120

Cylinder	Engine speed/cylinder rpm	Iss (A)	Engine speed Ref.187	Temperature °C Ref. 82
1	187	28		
12	188	26		
5	189	29		
8	189	23		
3	188	22		
10	188	27		
6	188	26		
7	187	27		
2	187	25		
11	187	26		
4	187	26		
9	186	26		
Minimum	186	22		
Maximum	189	29		
Difference	3	7		

See section A for Test and adjustment data.

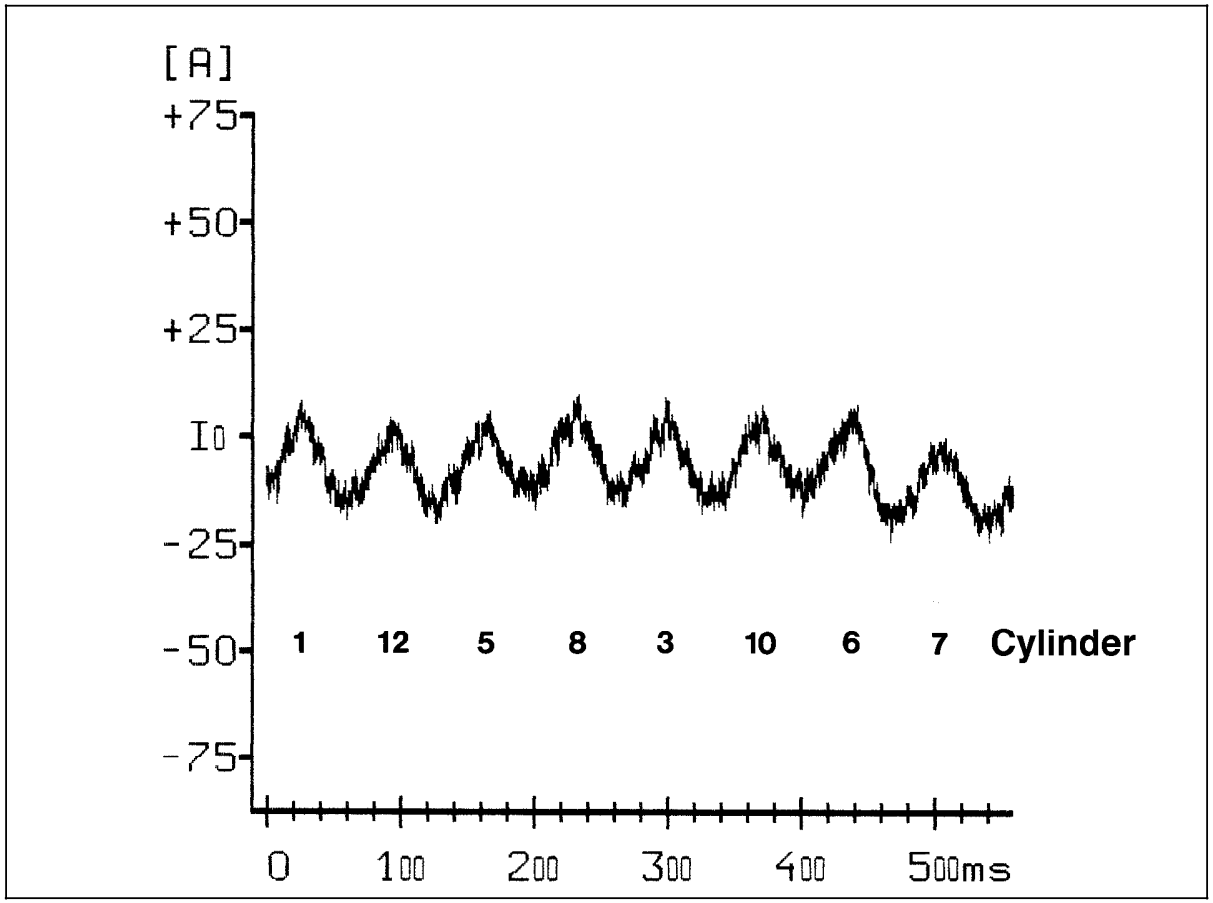
Diagnosis – Cylinder Analysis

Compression (dynamic)

12–cylinder engine scope pattern, Engine 120
Good scope pattern.
The relation of the curve to the cylinders is determined by the entered firing sequence 1–12–5–8–3–10–6–7–2–11–4–9, starting with cylinder 1.

Starter speed	187 rpm
Current	311 A
Engine oil temperature	82 °C

On 12-cylinder engines, the scope pattern is continued on the following page with cylinder 7 and 2.



P07-5118-57

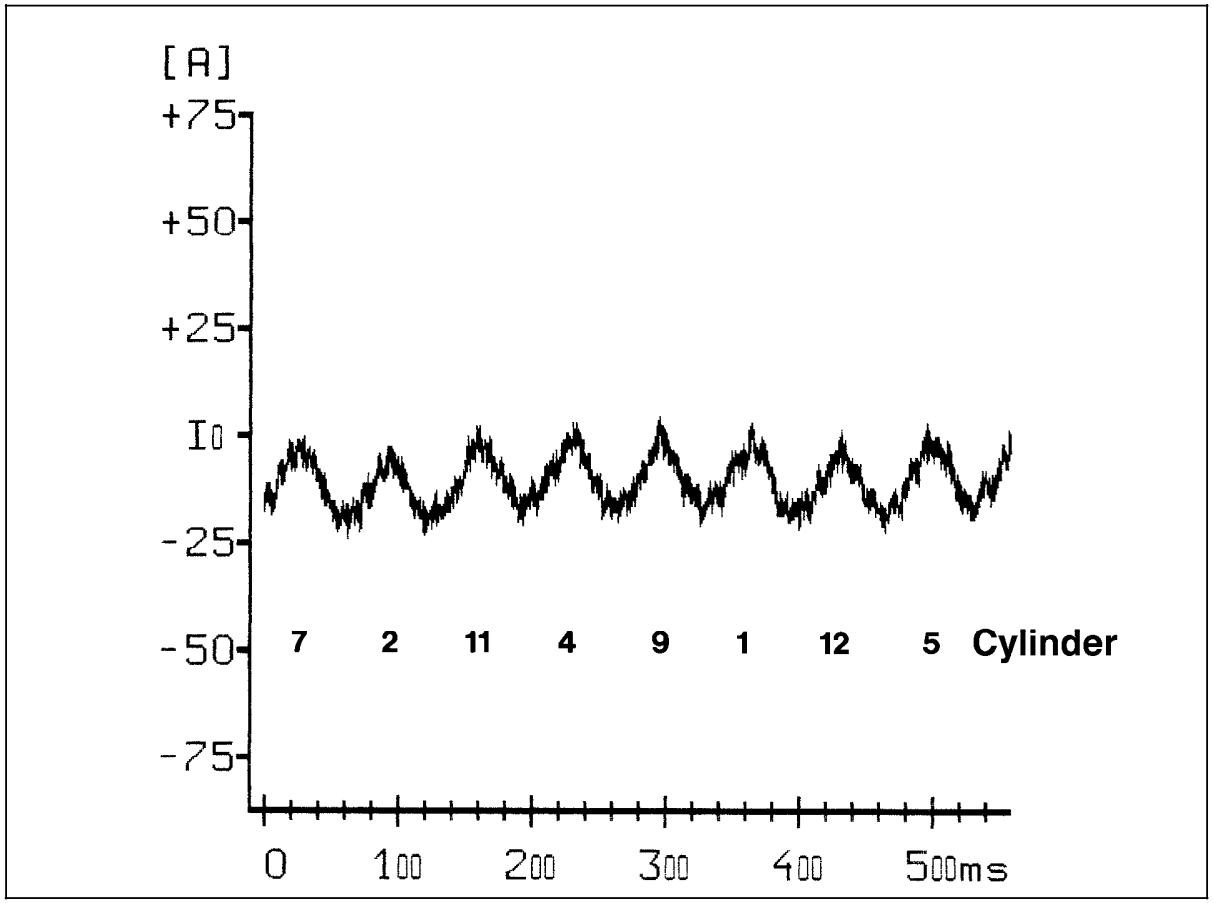
Figure 9

Diagnosis – Cylinder Analysis

Compression (dynamic)

12–cylinder engine scope pattern, Engine 120
Good scope pattern.
Continuation of scope pattern on second page.

Starter speed	187 rpm
Current	311 A
Engine oil temperature	82 °C



U07-5119-57

Figure 10

Diagnosis – Cylinder Analysis

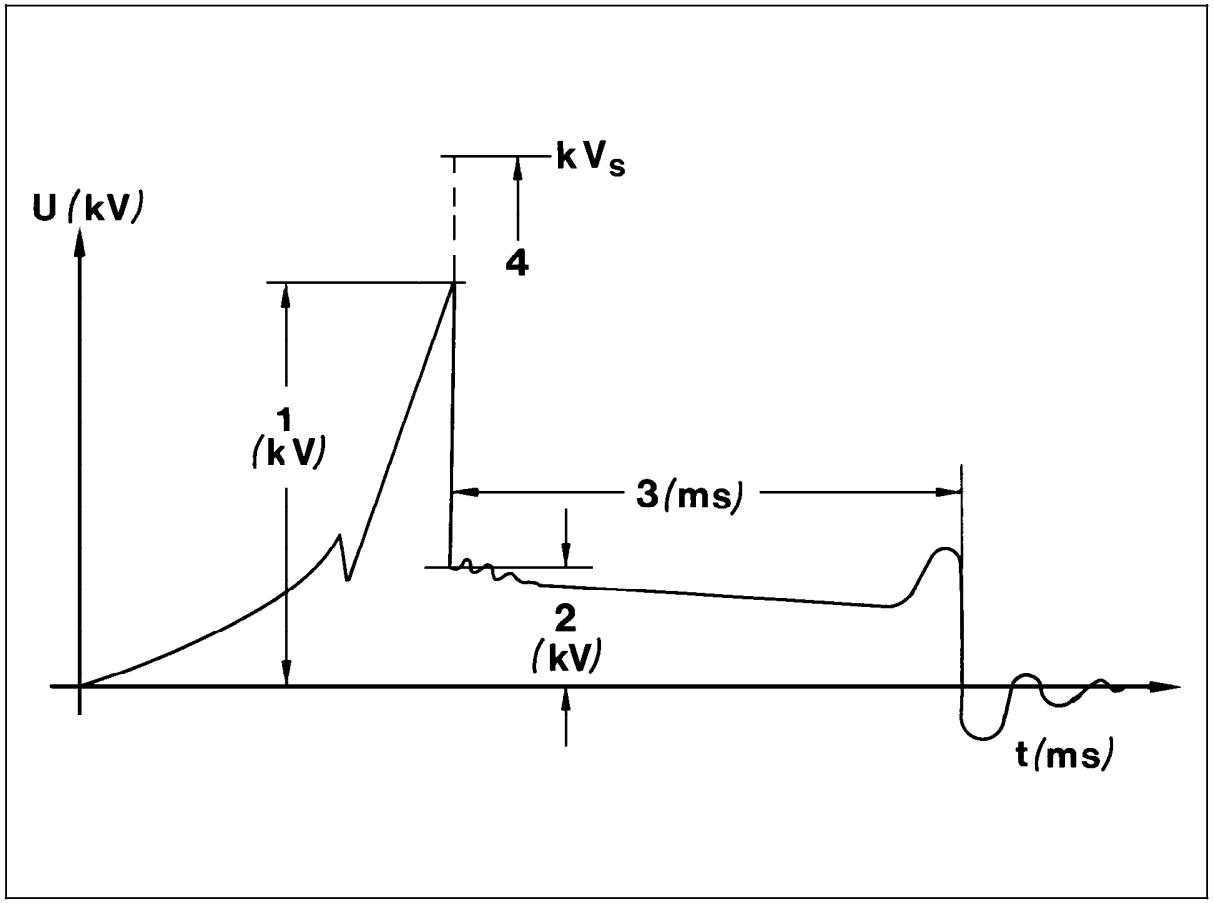
Ignition System

⚠

This test program is not suitable for HFM-SFI engines, due to the complexity of the fuel injection system on.

General information

With this test program, all existing constant (non-intermittent) ignition system faults can be recognized by their numerical value.
For details see Figure 11.
For intermittent faults, the oscilloscope should be used (see 48/2). The numerical values can be read from the oscilloscope.
See section “A” for Test and adjustment data.



P15-0196-57

Figure 11

1 Ignition voltage U (kV)
2 Projection point, burn voltage (kV)
3 Burn time, burn voltage line t (ms)
4 Ignition voltage, peak value (kV max)

Diagnosis – Cylinder Analysis

Ignition System

a) 4–cylinder engine, Engine 102

During the **Ignition system** program the following data must appear on the engine analyzer:

Cylinder	Engine speed rpm	Engine oil temperature °C	Ignition voltage		Projection point, burn voltage	
			kV max [1]	kV	kV	ms
Ref.	855	69				
1			15	13.0	1.0	2.6
3			14	10.0	1.4	1.8
4			12	10.5	1.0	2.6
2		**Defective cylinder**	**11**	7.8	**0.9**	**1.9**
Minimum				7.8	0.9	1.8
Maximum				13.0	1.4	2.6
Difference				5.2	0.5	0.9

[1] The “kV max values” are stored peak values.
They are used to evaluate the spark plugs after brief acceleration.
The kilovolt clamp must be positioned as close as possible to the ignition coil.

Note:

The data shown is a representative example of a 4–cylinder engine. The data in actual tests will vary.

Diagnosis – Cylinder Analysis

Ignition System

b) 6–cylinder engine, Engine 103

During the **Ignition system** program the following data must appear on the engine analyzer:

Cylinder	Engine speed rpm	Engine oil temperature °C	Ignition voltage		Projection point, burn voltage	
			kV max [1]	kV	kV	ms
Ref.	855	69				
1			15	13.0	1.0	2.6
5			14	10.0	1.4	1.8
3			12	10.5	1.0	2.6
6			13	11.3	1.0	2.7
2		**Defective cylinder**	**10**	**7.3**	**0.8**	**1.5**
4			12	12.2	1.2	1.7
Minimum				7.3	0.8	1.5
Maximum				13.0	1.4	2.6
Difference				5.7	0.6	0.9

[1] The “kV max values” are stored peak values.
They are used to evaluate the spark plugs after brief acceleration.
The kilovolt clamp must be positioned as close as possible to the ignition coil.

Note:

The data shown is a representative example of a 6–cylinder engine. The data in actual tests will vary.

Diagnosis – Cylinder Analysis

Ignition System

c) 8–cylinder engine, Engine 116/117

During the **Ignition system** program the following data must appear on the engine analyzer:

Cylinder	Engine speed rpm	Engine oil temperature °C	Ignition voltage		Projection point, burn voltage	
			kV max [1]	kV	kV	ms
Ref.	673	88				
1			15	12.3	1.2	1.7
5			12	10.3	1.0	1.6
4			14	11.5	1.2	1.8
8			12	9.5	1.0	1.7
6			14	12.3	1.1	1.8
3		**Defective cylinder**	**11**	**7.8**	**0.9**	**1.9**
7			14	12.0	1.2	1.8
2			11	9.5	1.0	1.7
Minimum				7.3	0.9	1.6
Maximum				13.0	1.2	1.9
Difference				5.7	0.3	0.3

[1] The “kV max values” are stored peak values.
They are used to evaluate the spark plugs after brief acceleration.
The kilovolt clamp must be positioned as close as possible to the ignition coil.