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Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 6: Diagnostic trouble code definitions

Véhicules routiers — Communications entre un véhicule et un équipement externe pour le diagnostic relatif aux émissions —

Partie 6: Définition des codes d'anomalie de diagnostic

Reference number
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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15031-6 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 15031 consists of the following parts, under the general title *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics*:

— *Part 1: General information*

— *Part 2: Terms, definitions, abbreviations and acronyms*

— *Part 3: Diagnostic connector and related electrical circuits, specification and use*

— *Part 4: External test equipment*

— *Part 5: Emissions-related diagnostic services*

— *Part 6: Diagnostic trouble code definitions*

— *Part 7: Data link security*

Introduction

ISO 15031 consists of a number of parts which taken together provide a coherent self-consistent set of specifications to facilitate emissions-related diagnostics. Parts 2 through 7 are based on SAE-recommended practices.

This part of ISO 15031 is based on SAE J2012: MAR99 (Recommended Practice for Diagnostic Trouble Code Definitions).

ISO 15031-1 provides an introduction to the series of International Standards.

Most automobile manufacturers equip at least a portion of their product line with some on-board diagnostic (OBD) capability. These systems provide an indication as to the general location of the diagnosed malfunction. This information is provided through an alphanumeric code.

Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 6:
Diagnostic trouble code definitions

1 Scope

This part of ISO 15031 provides recommended uniformity for alphanumeric trouble codes. It further provides guidance for uniform messages associated with these codes.

It specifies several sections addressing format, structure, messages and a few examples, and is applicable to electrical/electronic systems diagnostics of motor vehicles.

Annex A specifies the diagnostic trouble code naming guidelines for signals from components, signals to components, system based diagnostics, and signals using a subfault strategy.

Annex B specifies the actual code assignments and description for powertrain system diagnostic trouble codes.

Annex C specifies the actual code assignments and description for network communication system diagnostic trouble codes, body system diagnostic trouble codes, and chassis system diagnostic trouble codes.

Annex D specifies the DTC failure category and Subtype definition of the DTC failure type byte which is an extension of a base DTC to more precisely describe the fault symptom of the DTC.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TR 15031-2, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 2: Terms, definitions, abbreviations and acronyms*

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15031-2 and the following apply.

3.1
circuit/open
fixed value or no response from the system where specific high or low detection is not feasible or can be used in conjunction with circuit low and high codes where all three circuit conditions can be detected

NOTE The term “malfunction” has, in most cases, been deleted from the DTC description.

3.2
range/performance
circuit in the normal operating range, but not correct for current operating conditions

NOTE This may be used to indicate stuck or skewed values indicating poor performance of a circuit, component or system.

3.3
low input
circuit voltage, frequency, or other characteristic measured at the control module input terminal or pin that is below the normal operating range

3.4
high input
circuit voltage, frequency, or other characteristic measured at the control module input terminal or pin that is above the normal operating range

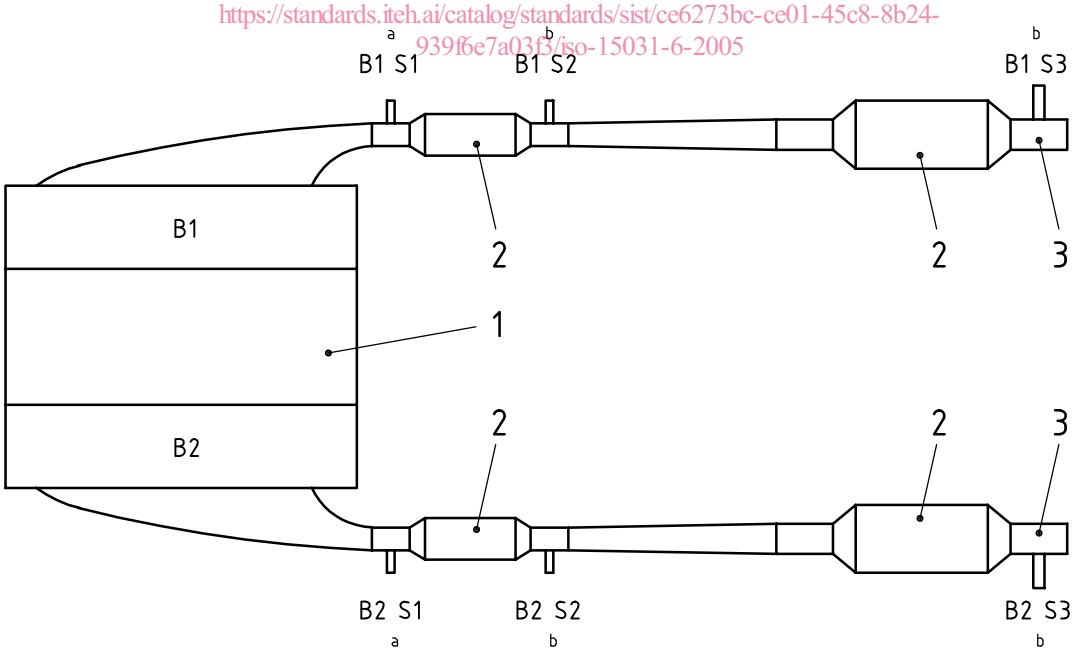
3.5
bank
specific group of cylinders sharing a common control sensor

NOTE 1 Bank 1 always contains cylinder number 1; bank 2 is the opposite bank.

NOTE 2 If there is only one bank, bank 1 DTCs are used, and the word “bank” may be omitted. With a single bank system using multiple sensors, bank 1 is used.

3.6
sensor location
location of a sensor in relation to the engine air flow, starting from the fresh air intake through to the vehicle tailpipe or fuel flow from the fuel tank to the engine, numbered in order 1, 2, 3 and so on

NOTE See Figure 1 through Figure 7.

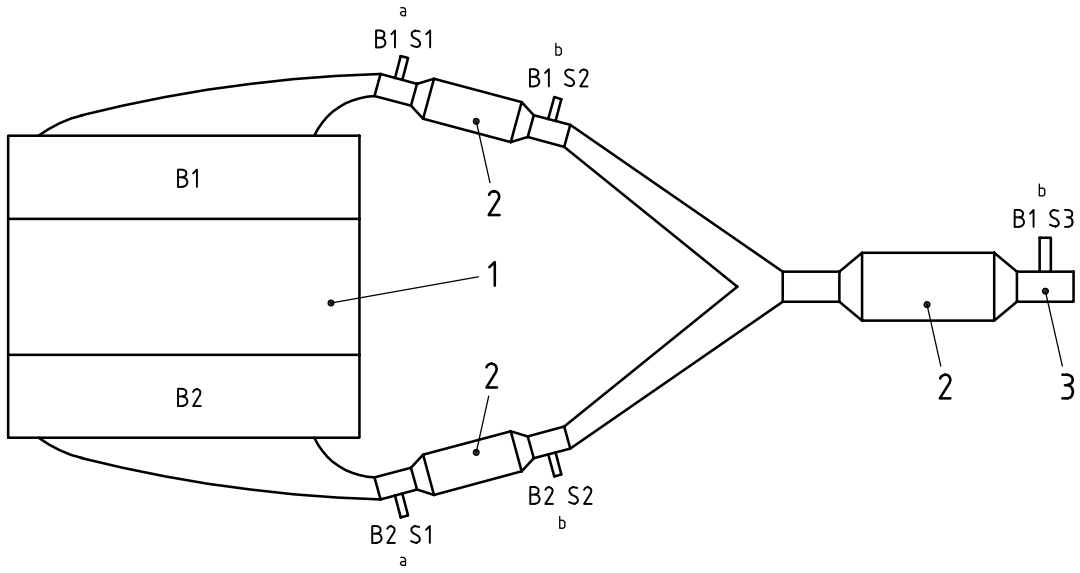


Key

B1	cylinder Bank 1	S1	sensor 1	1	V6/V8/V12 cylinder engine with exhaust banks
B2	cylinder Bank 2	S2	sensor 2	2	catalyst
		S3	sensor 3	3	tail pipe

a wide range
b heated

Figure 1 — Example of V6/V8/V12 cylinder engine with two exhaust banks and four catalysts

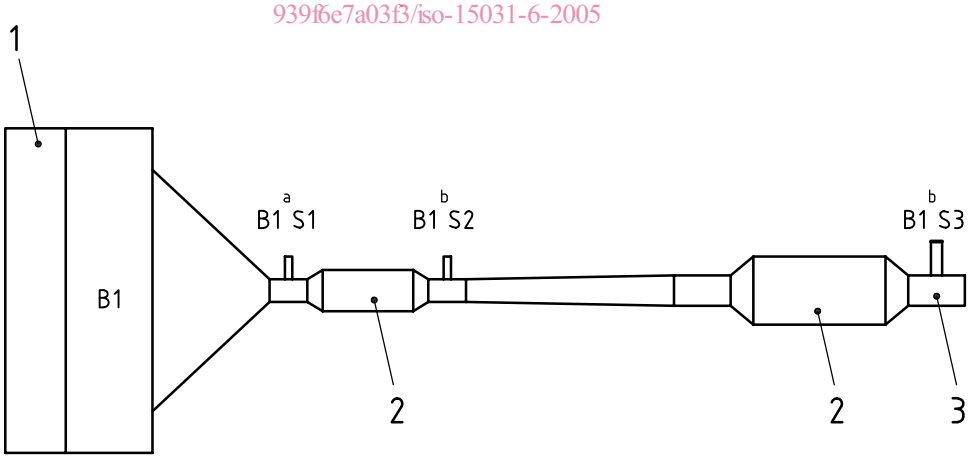


Key

B1	cylinder Bank 1	S1	sensor 1	1	V6/V8/V12 cylinder engine with exhaust banks
B2	cylinder Bank 2	S2	sensor 2	2	catalyst
		S3	sensor 3	3	tail pipe

[a] wide range
[b] heated

Figure 2 — Example of V6/V8/V12 cylinder engine with two exhaust banks and three catalysts

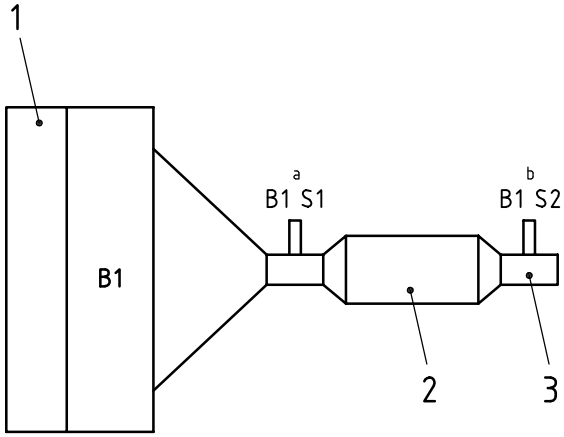


Key

B1	cylinder Bank 1	S1	sensor 1	1	4-cylinder engine with exhaust banks
		S2	sensor 2	2	catalyst
		S3	sensor 3	3	tail pipe

[a] wide range
[b] heated

Figure 3 — Example of L4/L5/L6 cylinder engine with one exhaust bank and two catalysts



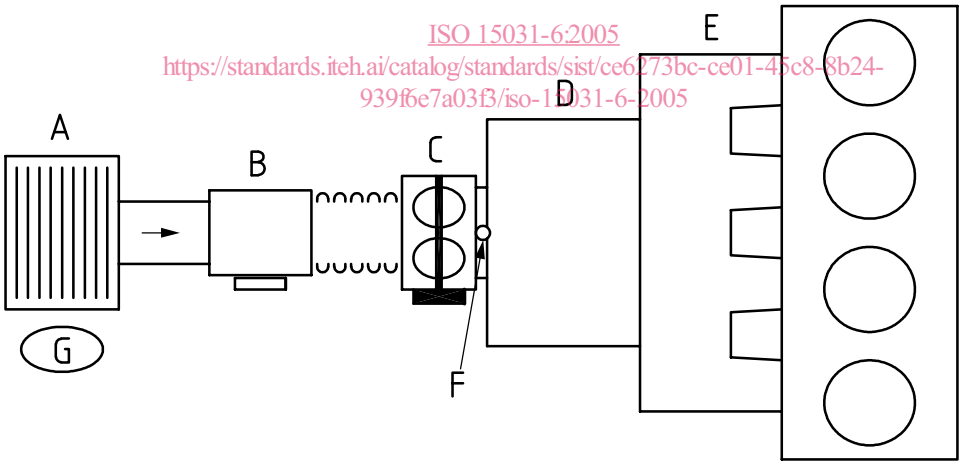
Key

B1	cylinder Bank 1	S1	sensor 1	1	4-cylinder engine with exhaust banks
		S2	sensor 2	2	catalyst
				3	tail pipe

[a] wide range
[b] heated

Figure 4 — Example of L4/L5/L6 cylinder engine with one exhaust bank and one catalyst

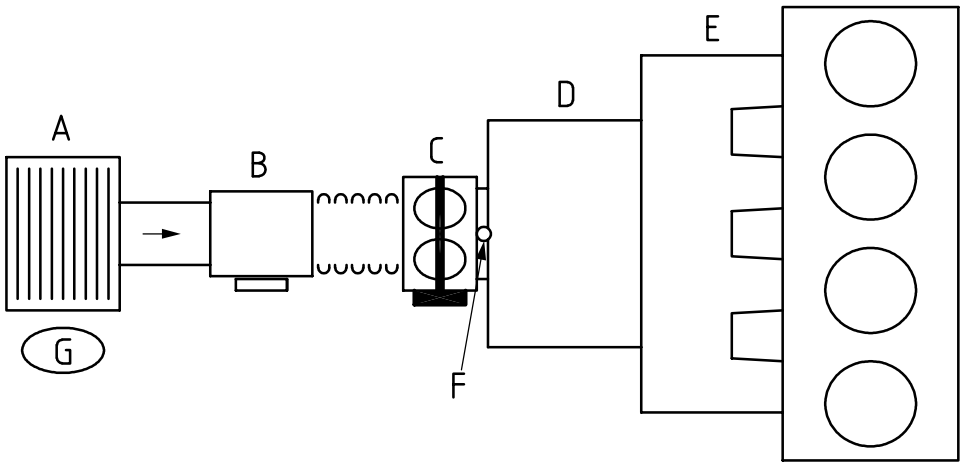
Intake air system pressure sensor location for boosted applications in relation to the engine air flow, including the fresh air inlet, boost device and engine manifold.



Components

A air cleaner
B MAF
C throttle body
D turbocharger/supercharger
E MAP (manifold pressure closest to the intake valves)
F inlet (pressure after the throttle body, but before the pressurizing device)
G BARO (atmospheric pressure)

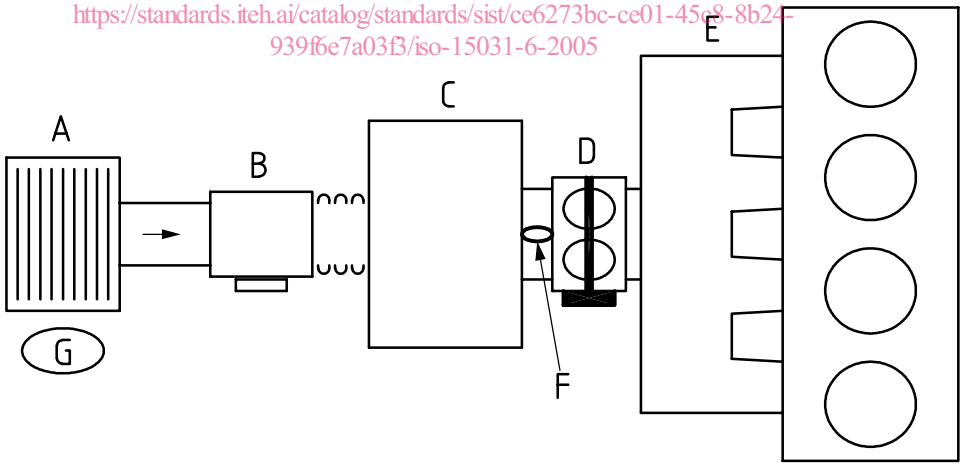
Figure 5 — Turbocharger/supercharger pressure sensor location draw-thru system



Components

A air cleaner
B MAF
C throttle body
D turbocharger/supercharger
E MAP (manifold pressure closest to the intake valves)
F boost (pressure after the pressurizing device, but before the throttle body)
G BARO (atmospheric pressure)

Figure 6 — Turbocharger/supercharger pressure sensor location blow-thru system



Components

A air cleaner
B MAF
D Turbocharger/supercharger
E MAP (manifold pressure closest to the intake valves)
G BARO (atmospheric pressure)

Figure 7 — Turbocharger/supercharger pressure sensor location no throttle body (diesel)

3.7
left/right and front/rear
component identified by its position as if it can be viewed from the drivers seating position

3.8
"A" "B"
manufacturer defined when components indicated by a letter

3.9
intermittent/erratic
temporarily discontinuous signal where the duration of the fault is not sufficient to be considered open or short, or the rate of change is excessive

4 General specifications

Table 1 specifies systems, code categories, hexadecimal values and particular sections of electrical/electronic systems diagnostic.

Table 1 — General code specifications

System	Code categories	Hex value	Appendix
Body	B0*xxx* – B3*xxx*	8*xxx* – B*xxx*	B
Chassis	C0*xxx* – C3*xxx*	4*xxx* – 7*xxx*	C
Powertrain	P0*xxx* – P3*xxx*	0*xxx* – 3*xxx*	P
Network	U0*xxx* – U3*xxx*	C*xxx* – F*xxx*	U

The recommended DTCs consist of a three-digit numeric code preceded by an alphanumeric designator. The alphanumeric designators are "B0", "B1", "B2", "B3", "C0", "C1", "C2", "C3", "P0", "P1", "P2", "P3", "U0", "U1", "U2", "U3", corresponding to four sets of body, four sets of chassis, four sets of powertrain and four sets of network trouble codes. The code structure itself is partially open-ended. A portion of the available numeric sequences (portions of "B0", "C0", "P0", "P2", "P3", "U0" and "U3") is reserved for uniform codes assigned by this or future updates. Detailed specifications of the DTC format structure are specified in Clause 5. Most circuit, component, or system diagnostic trouble codes that do not support a subfault strategy are specified by four basic categories:

— Circuit/open,

— Range/performance,

— Circuit low, and

— Circuit high.

Circuit low is measured with the external circuit, component, or system connected. The signal type (voltage, frequency, etc.) shall be included in the message after circuit low or circuit high.

Circuit high is measured with the external circuit, component, or system connected. The signal type (voltage, frequency, etc.) may be included in the message after circuit low or circuit high.

5 Format structure

5.1 Description

The diagnostic trouble code consists of an alphanumeric designator, B0-B3 for body, C0-C3 for chassis, P0-P3 for powertrain, and U0-U3 for network communication, followed by three characters. The assignment of the proper alpha designator should be determined by the area most appropriate for that function. In most cases, the alpha designator will be implied since diagnostic information will be requested from a particular controller. However, this does not imply that all codes supported by a particular controller shall have the same alphanumeric designator. The codes are structured as in Figure 8.

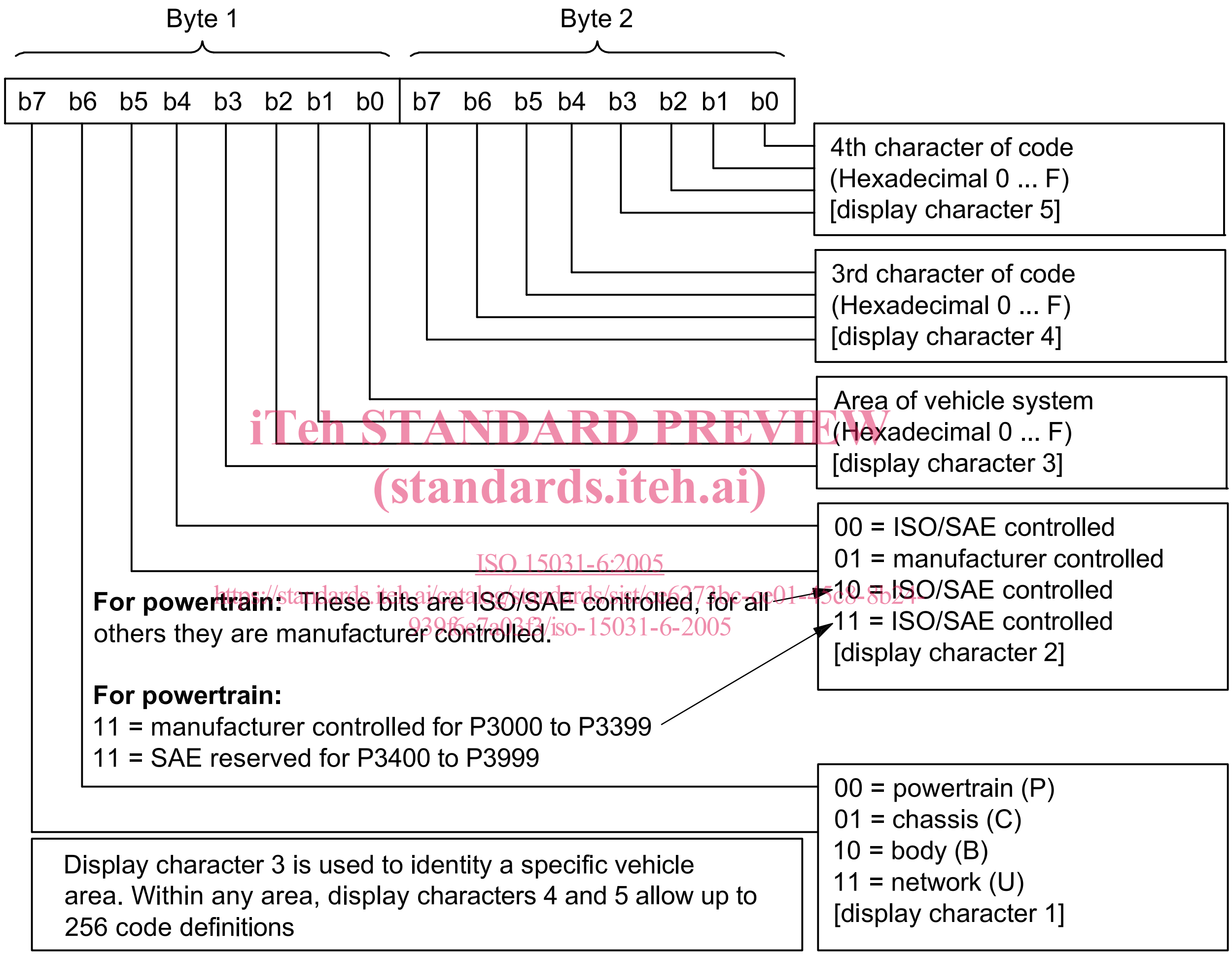

Byte 1
Byte 2
b7 b6 b5 b4 b3 b2 b1 b0
b7 b6 b5 b4 b3 b2 b1 b0
4th character of code
(Hexadecimal 0 ... F)
[display character 5]
3rd character of code
(Hexadecimal 0 ... F)
[display character 4]
Area of vehicle system
(Hexadecimal 0 ... F)
[display character 3]
00 = ISO/SAE controlled
01 = manufacturer controlled
10 = ISO/SAE controlled
11 = ISO/SAE controlled
[display character 2]
For powertrain: These bits are ISO/SAE controlled, for all others they are manufacturer controlled.
For powertrain:
11 = manufacturer controlled for P3000 to P3399
11 = SAE reserved for P3400 to P3999
00 = powertrain (P)
01 = chassis (C)
10 = body (B)
11 = network (U)
[display character 1]
Display character 3 is used to identity a specific vehicle area. Within any area, display characters 4 and 5 allow up to 256 code definitions

Figure 8 — Structure of diagnostic trouble codes

EXAMPLE 1 The 2-byte DTC as a data bus value $9234 would be displayed to technicians as the manufacturer controlled body code B1234 (see Figure 9).

DTC High Byte									**DTC Low Byte**							
$9				**$2**					**$3**				**$4**			
1	0	0	1	0	0	1	0		0	0	1	1	0	1	0	0
B		**1**		**2**					**3**				**4**			

Figure 9 — Example of 2-byte diagnostic trouble code structure

EXAMPLE 2 The 3-byte DTC as a data bus value $923400 would be displayed to technicians as the manufacturer controlled body code B1234-00 (see Figure 10). See Annex D for DTC Low Byte (Failure Type Byte) definitions. The low byte shall be displayed in hexadecimal format, e.g. $1A shall be displayed as 1A.

DTC High Byte									DTC Middle Byte									DTC Low Byte								
$9				$2					$3				$4					$0				$0				
1	0	0	1	0	0	1	0		0	0	1	1	0	1	0	0		0	0	0	0	0	0	0	0	
B		1		2					3				4					0				0				

Figure 10 — Example of 3-byte diagnostic trouble code structure

Codes have been specified to indicate a suspected trouble or problem areas, and are intended to be used as a directive to the proper service procedure. To minimize service confusion, fault codes should not be used to indicate the absence of problems or the status of parts of the system (e.g. powertrain system O.K., or MIL activated), but should be confined to indicate areas in need of service attention.

Ranges have been expanded beyond 100 numbers by using the hexadecimal base 16 number system.

5.2 ISO/SAE controlled codes (core DTCs)

ISO/SAE-controlled diagnostic trouble codes are those codes where industry uniformity has been achieved. These codes were felt to be common enough across most manufacturers' applications that a common number and fault message could be assigned. All unspecified numbers in each grouping are ISO/SAE reserved for future growth. Although service procedures may differ widely amongst manufacturers, the fault being indicated is common enough to be assigned a particular fault code. Codes in this area are not to be used by manufacturers until they have been approved by ISO/SAE.

5.3 Manufacturer controlled codes (non-uniform DTCs)

Areas within each alpha designator have been made available for manufacturer-controlled DTCs. These are fault codes that will not generally be used by a majority of the manufacturers due to basic system differences, implementation differences, or diagnostic strategy differences. Each vehicle manufacturer or supplier who designs and specifies diagnostic algorithms, software and diagnostic trouble codes are strongly encouraged to remain consistent across their product line when assigning codes in the manufacturer-controlled area. For powertrain codes, where possible, the same groupings should be used as in the ISO/SAE controlled area, i.e. 100's and 200's for fuel and air metering, 300's for ignition system or misfire, etc.

While each manufacturer has the ability to define the controlled DTCs to meet its specific controller algorithms, all DTC words shall meet ISO 15031-2.

5.4 Body system groupings (DTC numbers and descriptions are given in Annex C)

5.4.1 B0XXX ISO/SAE controlled

5.4.2 B1XXX manufacturer controlled

5.4.3 B2XXX manufacturer controlled

5.4.4 B3XXX reserved by document

5.5 Chassis system groupings (DTC numbers and descriptions are given in Annex C)

5.5.1 C0XXX ISO/SAE controlled

5.5.2 C1XXX manufacturer controlled

5.5.3 C2XXX manufacturer controlled

5.5.4 C3XXX reserved by document

5.6 Powertrain system groupings (DTC numbers and descriptions are given in Annex B)

5.6.1 P0XXX ISO/SAE controlled

5.6.2 P1XXX manufacturer control

5.6.3 P2XXX ISO/SAE controlled

5.6.4 P3XXX manufacturer controlled and ISO/SAE reserved

5.7 Network groupings (DTC numbers and descriptions are given in Annex C)

5.7.1 U0XXX ISO/SAE controlled

5.7.2 U1XXX manufacturer controlled

5.7.3 U2XXX manufacturer controlled

5.7.4 U3XXX manufacturer controlled and ISO/SAE reserved

6 Diagnostic trouble code descriptions

6.1 Diagnostic trouble code application

Recent developments have expanded the scope of this documentation to include additional DTCs and descriptions for network systems, body systems and chassis systems. Two different DTC application methods are required depending on the system. Powertrain DTCs require the assignment of a unique DTC number and description for each failure mode (e.g. circuit low, circuit high, rationality, etc.). Body and chassis systems descriptions are more general and require the assignment of a single DTC number and description for each component, not failure mode. Unique body and chassis failure mode identification is still possible, but is dependent upon using diagnostic protocols that support a subfault failure strategy. One example is ISO 14229-1, which uses a “Failure Type Byte” associated with each DTC to describe the failure mode (e.g. circuit low, circuit high, rationality, etc.). However, any protocol supporting a subfault strategy will work with these DTCs. Manufacturers shall select the appropriate failure mode to apply to the base DTC description.

6.2 Powertrain systems

The powertrain systems category covers functions that include engine, transmission and associated drivetrain accessories. For powertrain systems, each specified fault code has been assigned a description to indicate the circuit, component or system area that was determined to be at fault. The descriptions are organized such that different descriptions related to a particular sensor or system are grouped together. In cases where there are various fault descriptions for different types of faults, the group also has a “generic” description as the first code/message of the group. A manufacturer has a choice when implementing diagnostics, based on the specific strategy and complexity of the diagnostic.

Where more specific fault descriptions for a circuit, component or system exist, manufacturers should choose the code most applicable to their diagnosable fault. The descriptions are intended to be somewhat general to allow manufacturers to use them as often as possible yet still not conflict with their specific repair procedures.