INTERNATIONAL STANDARD

ISO 26021-2

First edition
2008-07-15

Road vehicles — End-of-life activation of on-board pyrotechnic devices —

Part 2: Communication requirements

Véhicules routiers — Activation de fin de vie des dispositifs pyrotechniques embarqués —

Partie 2: Exigences de communication

Reference number
ISO 26021-2:2008(E)

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Foreword

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ISO 26021-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 26021 consists of the following parts, under the general title *Road vehicles — End-of-life activation of on-board pyrotechnic devices*:

— *Part 1: General information and use case definitions*

— *Part 2: Communication requirements*

— *Part 3: Tool requirements*

— *Part 4: Additional communication line with bidirectional communication*

— *Part 5: Additional communication line with pulse width modulated signal*

NOTE Additional parts will be introduced as necessary to take into account requirements not yet covered by the standard.

Introduction

ISO 26021 describes a method for the in-vehicle deployment of pyrotechnically activated components (also referred to as pyrotechnic components or pyrotechnic devices) in cars.

Worldwide, nearly all new vehicles are equipped with one or more safety systems. Advanced protection systems using pyrotechnic actuators are becoming more common. All components which contain pyrotechnic substances should be handled in the same way.

Recycling of these vehicles requires a new process which ensures that the deactivation of airbags will be safe and cost-efficient. Based on the harmonization of the on-board diagnostics (OBD) interface, there is an opportunity to use this interface for on-board deployment, utilizing the same tools and processes.

The representatives of the global automobile industry have decided the following:

— automobile manufacturers do not support reuse as an appropriate treatment method for pyrotechnic devices;

— automobile manufacturers believe treatment of pyrotechnic devices is required before shredding;

— automobile manufacturers support in-vehicle deployment as the preferred method.

Based on this decision, the four major automobile manufacturer associations (ACEA, Alliance, JAMA and KAMA) started to develop a method for the in-vehicle deployment of pyrotechnic components in cars with the pyrotechnic device deployment tool (PDT). The vision is that, one day, a dismantler will need only one tool without any accessories in order to deploy all the pyrotechnic devices inside an end-of-life vehicle (ELV). The target is to use an existing interface to the car.

This part of ISO 26021 is applicable to the in-vehicle deployment of pyrotechnic devices in vehicles. It defines communication methods to be implemented by a pyrotechnic control unit (PCU) to allow the PDT to successfully establish and maintain communication with the PCUs in the vehicle to deploy all of the pyrotechnic devices sequentially.

Road vehicles — End-of-life activation of on-board pyrotechnic devices —

Part 2: Communication requirements

1 Scope

This part of ISO 26021 defines the deployment process, the system architecture, CAN-based communication methods and system preconditions which have to be implemented to fulfil the use cases defined in ISO 26021-1. Additionally, the relationship to and use with other existing standards are defined.

This part of ISO 26021 also describes the technical details of the on-board deployment method. The way in which the pyrotechnic devices contained in the vehicle function in conjunction with the PDT is the primary focus of this document. Under the provisions of this document, the design of the PDT or PCU can be implemented in accordance with specific functionality and hardware requirements.

This part of ISO 26021 specifies the access to the PCU. This includes communication as well as the logic sequences which are involved during the activation process.

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/IEC 10731, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

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

ISO 15031-3, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits, specification and use*

ISO 15765-2:2004, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 2: Network layer services*

ISO 15765-3:2004, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 3: Implementation of unified diagnostic services (UDS on CAN)*

ISO 15765-4, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 4: Requirements for emissions-related systems*

ISO 26021-1, *Road vehicles — End-of-life activation of on-board pyrotechnic devices — Part 1: General information and use case definitions*

ISO 26021-4, *Road vehicles — End-of-life activation of on-board pyrotechnic devices — Part 4: Additional communication line with bidirectional communication*

ISO 26021-5, *Road vehicles — End-of-life activation of on-board pyrotechnic devices — Part 5: Additional communication line with pulse width modulated signal*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14229-1 and the following apply.

3.1
key
data value sent from the external test equipment to the on-board controller in response to the seed in order to gain access to the locked services

3.2
pyrotechnic device deployment tool
tool designed to be plugged into the OBD interface in order to communicate via the internal computer network in an end-of-life vehicle with all control units which are able to activate pyrotechnic devices

NOTE This tool will comprise e.g. a computer, a connection between the computer and the diagnostic connector, and some software.

3.3
pyrotechnic control unit
PCU
electronic control unit in the vehicle network which controls the activation of pyrotechnic devices

3.4
safing
mechanism whose primary purpose is to prevent an unintended functioning of the PCU processor prior to detection of a crash situation

3.5
safing unit
part of the PCU (e.g. an electromechanically operated switch or a separate processor) that allows the pyrotechnic component deployment microprocessor (µP) to deploy the pyrotechnic devices via the driver stage

3.6
scrapping program module
module responsible for firing the selected pyrotechnic device loops one by one

3.7
scrapping program module loader
module responsible for converting the scrapping program module to an executable format

3.8
seed
pseudo-random data value sent from the on-board controller to the external test equipment, which is processed by the security algorithm to produce the key

4 Symbols and abbreviated terms

ACL	additional communication line
CAN	controller area network
ELV	end-of-life vehicle
OBD	on-board diagnostics

PCU	pyrotechnic control unit
PDT	pyrotechnic device deployment tool
RAM	random access memory
SPL	scrapping program module loader
SPM	scrapping program module
SRS	supplementary restraint system
μC	microcontroller

5 Conventions

ISO 26021 is based on the conventions for the definition of OSI services (see ISO/IEC 10731) as they apply to diagnostic services.

6 Pyrotechnic device deployment via on-board diagnostic architecture

6.1 Vehicle system description

ISO 26021 is based on a vision of the diagnostic network architecture in combination with the PCU deployment architecture that is described below.

The PCU is connected to the vehicle diagnostic connector in accordance with ISO 15031-3. The PDT communicates with the PCU on CAN_H and CAN_L, which are the mandatory vehicle interfaces.

Depending upon the specific architecture of the vehicle, the mandatory link of the PCU may be connected via a gateway to the diagnostic connector; thus a CAN interface in the PCU for the mandatory link may not be required.

During the deployment procedure, the vehicle PCUs shall be powered by the vehicle battery or, if the battery is flat, by connecting an external power source to the battery terminals.

This requires an undamaged electrical architecture for the devices involved.

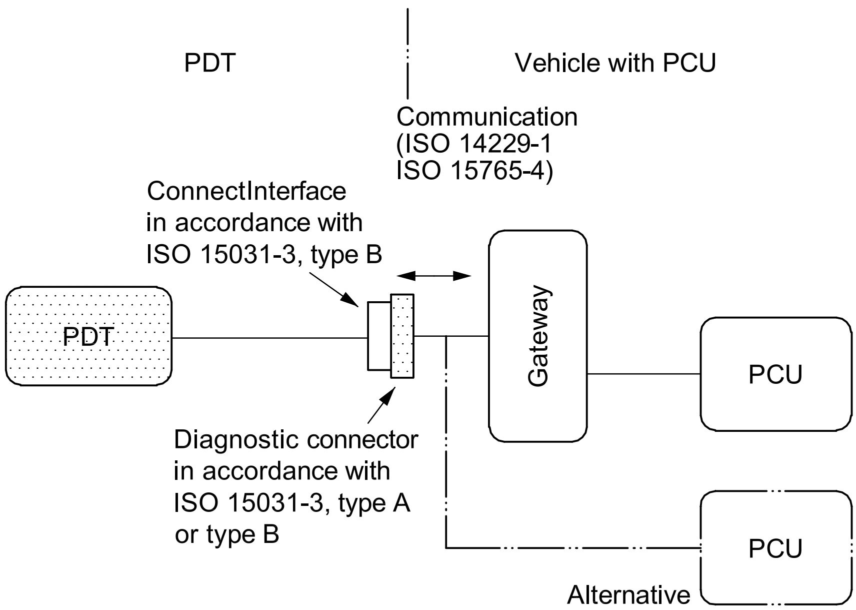

Figure 1 — Access to the vehicle via diagnostic connector

To interface the PCU with the vehicle, a PDT to diagnostic connector interface shall be used. The purpose of this interface is to

— provide the CAN bus interface and optional ACL interface with the vehicle;

— provide widely known standard wire interfaces like UART (RS232) or USB, or wireless interfaces like BLUETOOTH and WLAN.

The PDT could be based on a PC architecture running the operation system and application software from a bootable compact disc (CD) to avoid independence from software of any operating system, or the PDT could consist of a separate operating console.

6.2 Example of in-vehicle hardware and software required

To execute the on-board deployment via the communication link, the software inside the PCU shall have full access to the output driver stage, which controls the deployment loops.

In the solution without an ACL, a mechanical acceleration switch in the deployment loop circuit would not be able to carry out the redundant safing function.

To achieve a reasonable functionality without the classical safing design, an independent electronic safing unit is recommended due to the different safing philosophies of the various vehicle manufacturers. This unit could receive the required safing acceleration data from a second acceleration sensor inside the PCU or from an external frontal sensor.

Thus the deployment loop output stage is controlled by two independent branches. Depending on the safing philosophy of the vehicle manufacturer, the safing path could be controlled via the optional ACL or the main deployment processor.

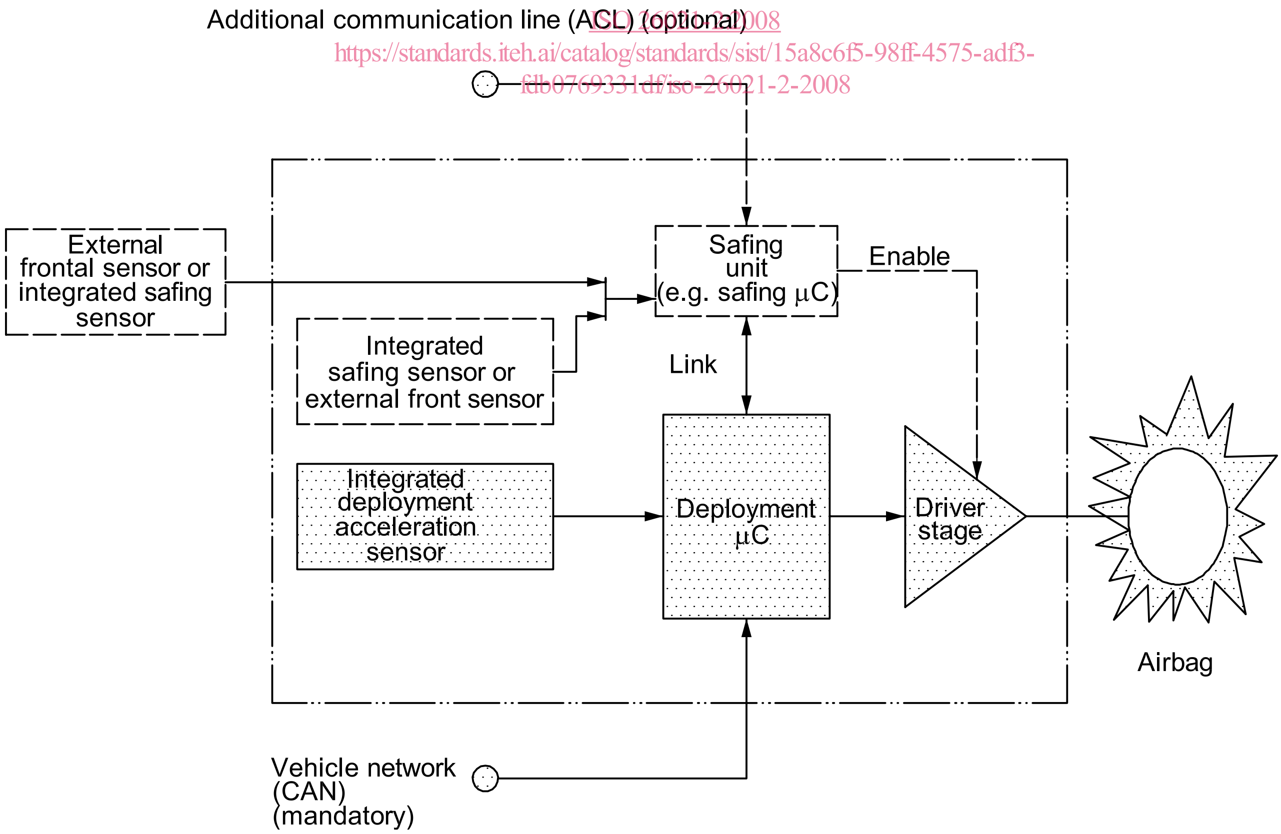

Figure 2 — Overview of hardware and software required

6.3 Additional communication line (optional)

For special safety requirements, an additional signal can be applied. General requirements for the interface between the deployment sequence and the ACL sequence are as shown in Figure 3.

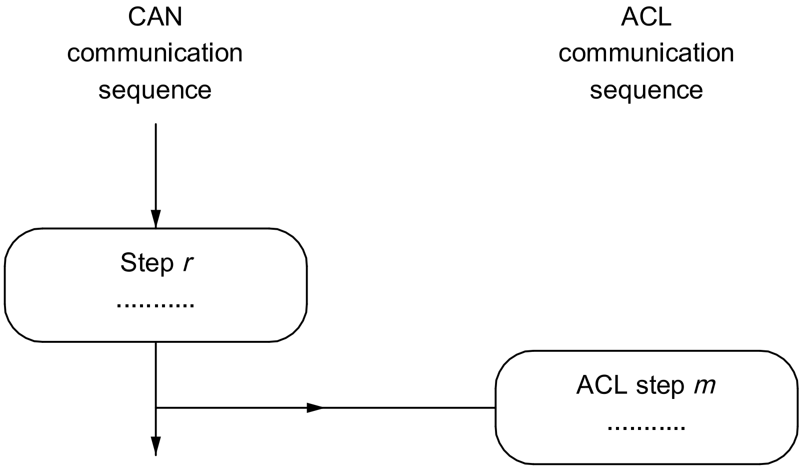

Figure 3 — Integration of ACL communication into deployment process

The standardized steps specify the diagnostic sequence. This type of step is mandatory. The PDT and the PCU shall behave as specified. The optional steps are necessary if the original equipment manufacturer (OEM) chooses the additional communication line. Optional ACL steps will depend on the use of the ACL option. Only while communicating with a PCU having an ACL is the PDT allowed to connect with the ACL line. These steps are mandatory only for the optional ACL. These optional steps are detailed in ISO 26021-4 and ISO 26021-5.

6.4 Requirements for the PDT

6.4.1 Power supply

This subclause defines the requirements for the PDT to be able to establish communication with the PCUs and successfully activate the pyrotechnic devices installed in the vehicle.

The PCUs shall be powered internally so that they are independent of the power supply of the vehicle even if pins 4 and 16 on the diagnostic connector provide a permanent power supply when the vehicle is powered.

This is to achieve robustness against a damaged power supply in the diagnostic connector. However, the tool may provide the capability to recharge its internal batteries using pins 4 and 16 of the diagnostic connector if the power supply on these pins has not been damaged.

6.4.2 Initial condition of vehicle

The operation can only start if full access to the vehicle is granted via a suitable identification method (e.g. ignition key or keyless entry unit).

It is necessary to ensure that the vehicle's electronic system is active for communication via the diagnostic connector.

6.4.3 Safety requirements

To execute the on-board deployment function via the diagnostic connection, a software module inside the PCU is required which performs the necessary steps to control the output stages, overrides the safing unit (alternative use of ACL) and carries out the communication to the PDT. To avoid any inadvertent deployment caused by the deployment software module in the PCU, it shall be stored in a non-executable format in the program memory of the PCU and shall only be activated by an SPL which is an executable program code.

A key code from the PDT is required to enable the SPL to load the SPM into the RAM and convert the SPM to an executable format.

After a further communication sequence of the PDT with the PCU, the SPM will communicate to the independent electronic safing unit (if no ACL is available), activate the output stages and record this event individually for each deployment loop.

When an ACL is present, the unlock signal on this line has to be present during the deployment event and evaluated by the independent safing unit to release the output.

After the deployment sequence of this particular PCU is completed, the PDT may request a reset of the PCU and the PCU exits the scrapping mode.

6.4.4 Suitability of vehicle

Vehicles that can be scrapped via the diagnostic connector will respond to the PDT. All others will not.

7 Relationship to existing standards

7.1 General

All clauses of ISO 11898-1, ISO 14229-1 and the relevant part of ISO 15765 are applicable for the PCU deployment process, with the restrictions/additions defined below.

7.2 Application layer

This part of ISO 26021 uses the application layer services and protocol as defined in ISO 14229-1 for client-server-based systems to perform functions such as initialization, monitoring or start of functions of on-board vehicle servers like the PCU.

7.3 Session layer

For security reasons, the scrapping sequence shall take place in the deployment session.

7.4 Application layer and diagnostic session management timing

This part of ISO 26021 uses the application layer and session layer timing parameters as defined in ISO 14229-1 and ISO 15765-3. The detailed timing parameter descriptions for physical communication and functional communication shall be in accordance with ISO 15765-3. Although functional communication is not necessary for this part of ISO 26021, ΔP2CAN shall be between 0 ms and 500 ms. The PDT needs to detect P2CAN_Client timeout and this part of ISO 26021 specifies the ΔP2CAN value for gateway design.

In the case of a communication error, it is assumed that the client and the server implement the application and session layer timing as defined in ISO 15765-3. The client (i.e. the PDT) shall repeat the last request a maximum of two (2) times, which means that the greatest number of service request transmissions is three (3).

In the case of the worst-case communication error, the PDT shall stop the execution of the deployment process.

7.5 Network layer

The network layer of the external equipment (i.e. the PDT) and the vehicle, which may have one or more PCUs, shall be compliant with the standard diagnostic specification in ISO 15765-4, with the restrictions defined below:

— the PDT shall not transmit the FC.WAIT frame in the segmented response message;

— the PDT shall not transmit the FC frame with the non-zero block size (BS) parameter in the segmented response message;

— the PDT shall not transmit the FC frame with the non-zero separation time (STmin) parameter in the segmented response message;

— the maximum number of FC.Wait frame transmission (N_WFTmax) parameters shall be zero.

For the parameters used above, see ISO 15765-2:2004, Subclause 6.5.5, “FlowControl N_PCI parameter definition”.

From the external test equipment (PDT) point of view, each PCU in a compliant vehicle must have an addressed CAN identifier.

For the initialization sequence only, the normal addressing format and normal fixed addressing format as defined in ISO 15765-2 shall be used.

— 11 bit CAN identifiers: normal addressing;

— 29 bit CAN identifiers: normal fixed addressing.

After the initialization sequence, the OEM-specific combinations can be used as defined in Table 3 to Table 5.

7.6 Data link layer

7.6.1 11 bit CAN identifiers

Table 1 specifies the 11 bit CAN identifiers for safety-relevant initialization aspects, based on the defined mapping of the diagnostic addresses.

Table 1 — 11 bit safety-relevant identifiers

CAN identifier (hex)	Description
7F1	Physical request CAN identifier from the external test equipment to PCU #1
7F9	Physical response CAN identifier from PCU #1 to the external test equipment PDT

7.6.2 29 bit CAN identifiers

Table 2 specifies the 29 bit CAN identifiers for safety-relevant initialization aspects, based on the defined mapping of the diagnostic addresses.

Table 2 — 29 bit PCU deployment CAN identifiers

CAN identifier (hex)	Description
18 DA 53 F1	Physical request CAN identifier from the external test equipment to PCU 0x53 (hex)
18 DA F1 53	Physical response CAN identifier from PCU 0x53 (hex) to the external test equipment

The maximum number of safety-relevant ECUs in a PCU deployment compliant vehicle is not limited. The physical PCU diagnostic address of the fixed-address PCU is “0x53” hex. This address, embedded in the physical CAN identifiers, shall be unique to any one vehicle.

7.6.3 Mapping of network layer protocol data units to PCU address information of in-vehicle PCUs

The PCUAddressFormat byte defines the mapping of the request and response addresses into a 32 bit field as defined in Tables 3 to 5.

Table 3 — Reserved PCU Address Format

	8 bit field PCUAddress Format	32 bit field request/response address									
		Byte 1 (MSB)		Byte 2				Byte 3		Byte 4 (LSB)	
		31	24	23	19	18	16	15	8	7	0
Reserved	0x00	0x00, 0x00, 0x00, 0x00									
Reserved	0x07 … 0xFF	ISO/SAE reserved for future use									

Table 4 — Mapping of 11 bit N_PDU parameters into the 32 bit request/response address

11 bit mapping (e.g. CAN)	8 bit field PCUAddress Format	32 bit field request/response address See ISO 15765-2:2004, Subclause 7.3, Mapping of the N_PDU fields.									
		Byte 1 (MSB)		Byte 2				Byte 3		Byte 4 (LSB)	
		31	24	23	19	18	16	15	8	7	0
11 bit — normal addressing	0x01	0x00		0b0000 0		N_AI				0xFF (default)	
11 bit — extended addressing	0x02	0x00		0b0000 0		N_AI, except N_TA				N_TA	
11 bit — mixed addressing	0x03	0x00		0b0000 0		N_AI				N_AE	

Table 5 — Mapping of 29 bit N_PDU parameters into the 32 bit request/response address

29 bit mapping (e.g. CAN)	8 bit field PCUAddress Format	32 bit field request/response address See ISO 15765-2:2004, Subclause 7.3, Mapping of the N_PDU fields, and ISO 15765-3:2004, Subclause 8.3, Enhanced diagnostics 29 bit CAN identifiers.					
		Byte 1 (MSB)	**Byte 2**		**Byte 3**		**Byte 4 (LSB)**
29 bit — normal fixed addressing	0x04	0x00	N_TA		N_SA		0xFF
29 bit — mixed addressing	0x05	0x00	N_TA		N_SA		N_AE
ISO 15765-3 mapping		31	22	21	11	10	0
Unique addressing	0x06	0b00 0110 1111		Unique source address		Unique destination address	

7.7 Data link layer

There is no addition or restriction to the data link layer.

7.8 Physical layer

The PDT shall support all legislated OBD baud rates. If this is not possible, the PDT shall support at least the baud rates of 250 kbit/s and 500 kbit/s.

8 Deployment process

8.1 General information

This clause defines the general steps in the deployment process. It starts with the interface requirements for the external test equipment. This is followed by a description of the deployment sequence. See also Figure 4.

8.2 System preconditions

8.2.1 General

If the minimum requirements (see 6.4.2) are not fulfilled, the deployment session cannot be started. All enable conditions shall be checked before the session is initiated.

If the PCU cannot determine whether the conditions are met (e.g. due to a system failure or because of the design), it shall be assumed the conditions are fulfilled.

8.2.2 Notification enable condition

After adequate notification of the user, the system should awaken and the power to the PCUs should be switched on.

If a signal “ignition key on” or other such information is available, these shall be checked.

8.2.3 Not in motion enable condition

If the information “vehicle is not in motion” is available, it shall be checked.