

# Conformity Assessment of Tanks for Air Braking Systems of Motor Vehicles in Accordance with EN 286-2

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Subject review

Bearing in mind that the internal European market must be protected against unsafe and dangerous products in all fields, including the field of motor vehicles, this paper presents the basic principles of the European standard 286-2, which deals with tanks for air braking systems of motor vehicles and their trailers. This harmonized standard supports the Directive 87/404/EEC, which deals with simple pressure vessels.

Since the tank for air braking system of motor vehicles, as a vessel under pressure, poses a security risk in the state of rest as well as during exploitation, this paper, through an example of modern pneumatic brake system in vehicles, provides a methodology for conformity assessment of the tanks of air braking system for motor vehicles and their trailers, in accordance with the EN 286-2 standard. The application of the described procedure defines the conditions that remove technical barriers in trade, protect the market from unsafe products, and thus increases traffic security.

## Ocjenjivanje usklađenosti rezervoara zračnih sistema kočenja kod motornih vozila prema EN 286-2

Pregledni članak

Imajući u vidu da se europsko unutrašnje tržište mora zaštititi od nesigurnih i opasnih proizvoda u svim područjima, pa tako i u području motornih vozila, u radu su prezentirana osnovna načela europskog standarda 286-2, koji se odnosi na rezervoare zračnog sustava kočenja kod motornih vozila i njihovih prikolica. Ovaj usklađeni standard podržava Propis 87/404/EEC koja se odnosi na jednostavne posude pod pritiskom.

S obzirom da zračni rezervoar kočnog sistema motornih vozila, kao posuda pod pritiskom, predstavlja sigurnosni rizik, kako u mirovanju, tako i u eksploataciji, u radu je, kroz primjer suvremenih pneumatskih sistema kočenja na vozilima, data metodologija ocjenjivanja usklađenosti rezervoara zračnih kočnih sustava motornih vozila i njihovih prikolica prema standardu EN 286-2. Primjenom opisane procedure definiraju se uvjeti kojima se uklanjaju tehničke barijere u trgovini, štiti tržište od nesigurnih proizvoda, a time i povećava sigurnost prometa.

## 1. Introduction

Braking systems represent very important parts of all motor vehicles and their trailers, both from the aspect of security and from the aspect of traffic realization. In that regard, looking at a braking system as an integrated and functional group of different sub-systems, one of these sub-systems is especially important – transmission mechanism, whose task is to transfer to the executive parts the impulses received from the command. Fulfilling of these tasks is very complicated, especially in the braking systems for vehicles with great total mass. These vehicles, among other things, are an example of application of pneumatic transmission mechanisms, which provide for activation of brakes exclusively by applying an external energy source, meaning compressed

air. From the aspect of security of these systems, air tank is especially significant, as a vessel under pressure, which is a security risk both in the phase of operation and in the state of rest.

Development of the construction and quality of air braking systems is constant and very intensive, which leads to introduction of new construction solutions and a number of changes, especially concerning materials and technology of their manufacture. That is why planning and development of new technologies is based primarily on the development of the system of quality, pursuant to standardization principles.

Harmonization and standardization of technical regulations in Europe is based on the principle of establishment of European New Approach Directives,

which define only the essential health and security requirements and refer to standards for more detailed technical specifications, meaning harmonized standards (HS). Each product harmonized with a corresponding standard is assumed to have been harmonized with a corresponding Directive, thus creating conditions for awarding of the CE (Conformité Européenne) mark and placing of the product into commercial circulation and distribution without limitations within the EU. CE mark is the only mark that symbolizes harmonization with all requirements related to the manufacturer, as required by the corresponding Directives. At the same time, it represents a guarantee that a product is harmonized with all applicable provisions and that it was subjected to adequate procedures of conformity assessment.

Conformity assessment, in accordance with EN 45020 – Standardization and related activities – General vocabulary, is defined as:

*«any activity concerned with determining directly or indirectly that relevant requirements are fulfilled».*

Practical realization of conformity assessment of a product is preceded by the following phases:

- determining of main requirements for products in accordance with product analysis and manufacturing technologies,
- determining of applicable directives and standards for products,
- providing conditions for implementation of procedures for assessment of conformity of a product with a standard.

In this concrete case, air braking tanks of motor vehicles and their trailers present products that must meet the requirements defined in Directive 87/404/EEC, which relates to simple vessels under pressure.

This Directive (with amendments 90/488/EEC – Introduction and transition period and 93/68/EEC – CE marking), was created as a result of the need for harmonizing of national regulations that determine the required level of security of simple vessels under pressure on the European level, which specify project and operational characteristics, conditions for installation and use, as well as control procedures before and after a product is placed on the market. The Directive contains mandatory and essential security requirements from the

**Table 1.** Harmonized standards from series EN 286

**Tablica 1.** Harmonizirani standardi serije EN 286

Harmonized standards / Harmonizirani standardi	Title of the harmonized standard / Naziv standarda
EN 286	Simple unfired pressure vessels designed to contain air or nitrogen / Jednostavna posuda pod pritiskom koja nije izložena plamenu dizajnirana za držanje zraka ili azota
EN 286-1:1998	Part 1: Pressure vessels for general purposes / Dio 1: Posude pod pritiskom za opću upotrebu
EN 286-1:1998/A1:2002	
EN 286-1:1998/A2:2005	
EN 286-1:1998/AC:2002	
<b>EN 286-2:1992</b>	<b>Part 2: Pressure vessels for air braking and auxiliary systems for motor vehicles and their trailers / Dio 2. Posude pod pritiskom za zračne kočnice i pomoćne sustave motornih vozila i njihovih prikolica</b>
<b>EN 286-2:1992/AC:1992</b>	
EN 286-3:1994	Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock / Dio 3: Čelične posude pod pritiskom dizajnirane za zračnu opremu kočenja i pomoćnu pneumatsku opremu za željeznička vozila
EN 286-4:1994	Part 4: Aluminum alloy pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock / Dio 4: Posude pod pritiskom od aluminijskih legura namijenjene za opremu za zračno kočenje i pomoćnu pneumatsku opremu za željeznička vozila

aspect of a risk resulting from damages to the serially made simple vessels under pressure.

Harmonized standard EN 286-2: Pressure vessels for air braking and auxiliary systems for motor vehicles and their trailers is one of four standards from the series EN 286, Parts 1-4, which meets the essential security requirements from the Directive 87/404/EEC and is specially emphasized in Table 1.

## 2. Basic Elements of Air Braking Systems for Motor Vehicles and their Trailers

Due to the complexity of tasks and harsh requirements that are required by the legislation<sup>1</sup>, air braking systems present complex constructions assembled from several sub-systems which bring together a number of fits and elements. Basic sub-systems of the braking system and functional components of each sub-system are shown in Figure 1.

Each of the sub-systems mentioned is structurally resolved in the same way, meaning it includes the same functional components: command, transmission mechanism and brake.

Basic groups of elements of a modern air system can be divided into three groups:

- Group for production of compressed air, which includes: compressor, air drier, pressure regulator, protection valves, air tanks, manometers;
- Group of pneumatic devices of a motor vehicle, which includes: brake valve of a motor vehicle, relay valves, brake valve for auxiliary and parking brakes, control valve of a trailer, brake cylinders, two-way valves, automatic governors for braking force;
- Group of pneumatic devices of a trailer, which includes: coupler head for supply, valves, tanks, brake cylinders, automatic governors for braking force.

All air braking systems possess a group of devices for preparation of compressed air, which presents the energy potential of the entire transmission mechanism. This system includes a compressor, which is driven by a motor with internal combustion and it compresses air up to the specific nominal pressure, which represents the working pressure of the transmission mechanism.

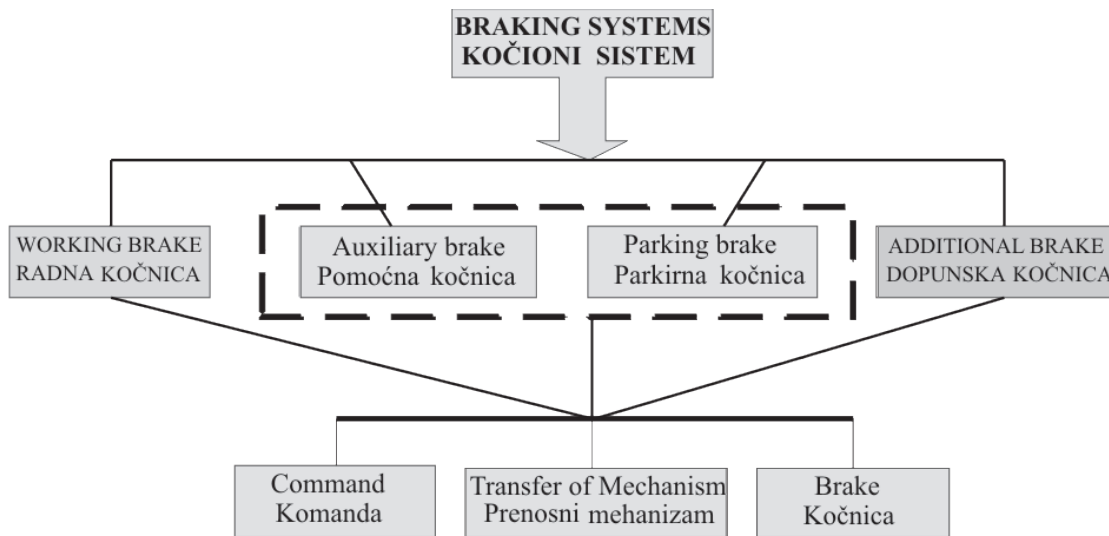


Figure 1. Basic sub-systems of braking system and functional components of the sub-system of braking system

Slika 1. Osnovni podsistemi sustav kočenja i njihove funkcionalne komponente

Source: developed by the authors

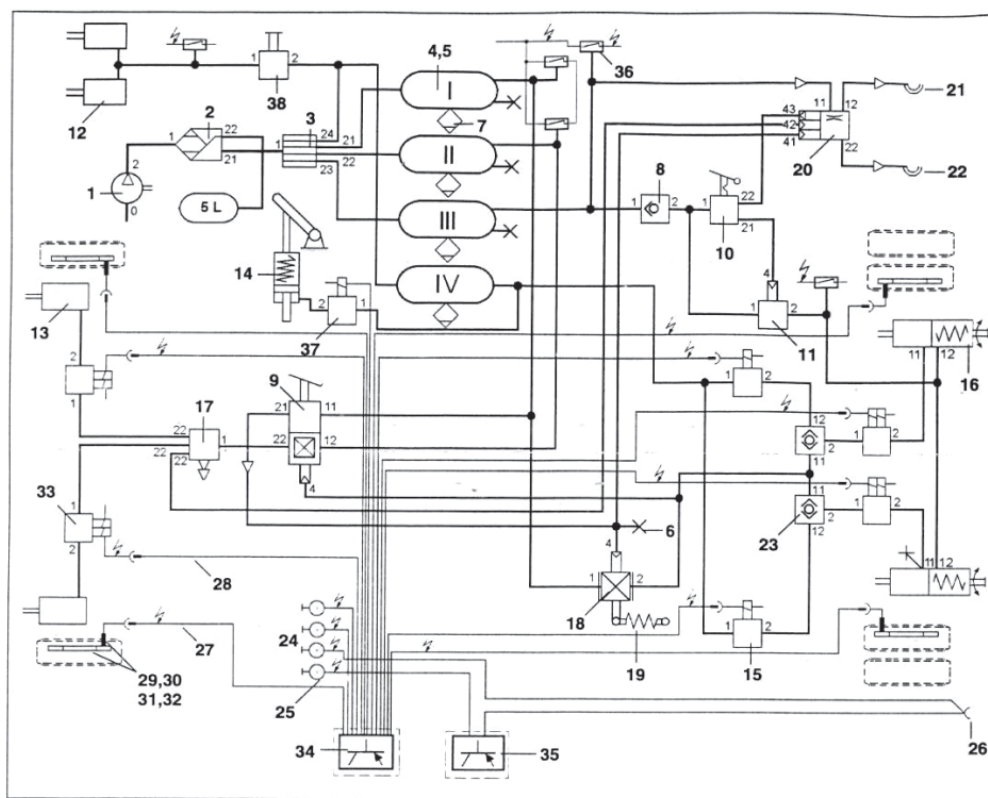
<sup>1</sup> Unique conditions for testing and conducting of mandatory homologation of vehicles (ECE Rulebooks). Design and testing of braking systems are defined by Rulebook EC 13 09.

Pressure in the installation, and in the same time the work of the compressor, is regulated by pressure regulator with an air dryer and an anti-freezing device. Compressed air is accumulated in tanks, through the regulator. With a command on the brake valve, compressed air is brought into the brake cylinders and the vehicle stops.

Structure of the air braking system depends primarily on the type of vehicle and its purpose. Lately, due to increasing requirements in the fields of security, operation and driver's and passengers' comfort, modern air braking systems have additional functions, thus the basic air braking system is supplemented by the ABS (Anti-Lock-Braking-System), ASR (Antischlupfregelung), and EBS (Electro Braking System).

To illustrate this, Figures 2 and 3 provides schemes of dial circuit-dual air braking system with ABS/ASR (4S/4M) for a motor vehicles and its trailer (category N<sub>3</sub> and O<sub>3</sub>)<sup>2</sup> by manufacturer WABCO, with positioned air tanks, system for supplying of air to the tank and systems for distribution of compressed air.

Air from the atmosphere is led to the compressor, position 1, which is driven by the I.C.E. (Internal Combustion Engine) and compresses air to the specific nominal pressure, which represents the working pressure of the transmission mechanism. Pressure in the installation, as well as the work of the compressor, is regulated by regulator, position 2. Also taking part in preparation of compressed air is a device for air filtering, air drier and an anti-freezing device.

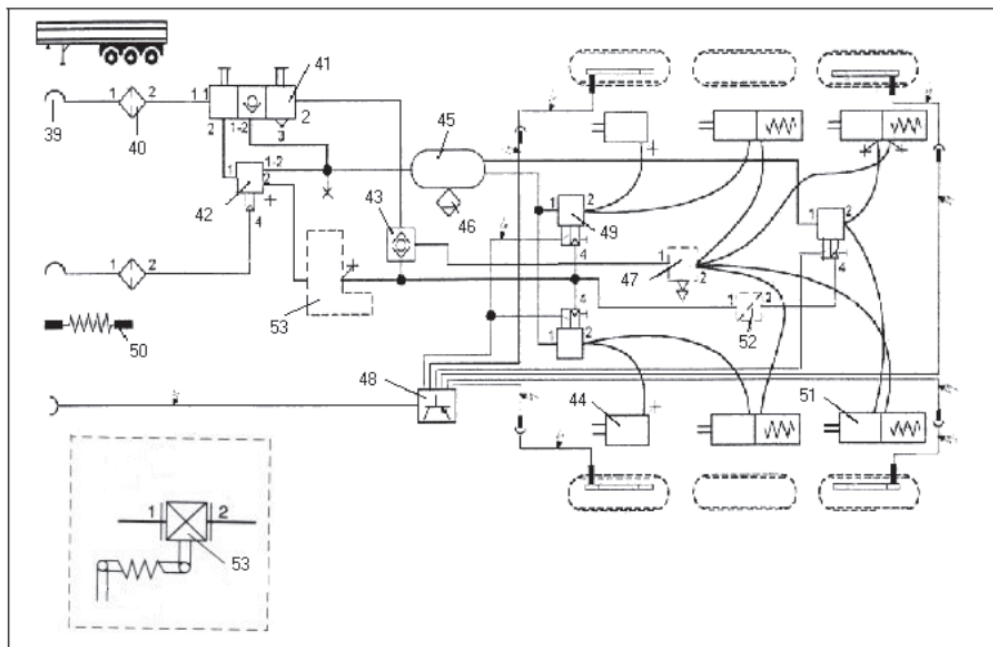


**Figure 2.** Dial circuit-dual air braking system with ABS/ASR (4S/4M): 1) Air compressor, 2) Regulator of pressure with air drier, 3) Four-circuit protection valve, 4, 5) Tanks for air, 9) Braking valve for motor vehicles, 16) Tristop cylinder, 21) Coupler head for supply.

**Slika 2.** Dvokružni–dvovodi zračni kočioni sustav sa ABS/ASR (4S/4M): 1) Kompresor, 2) Regulator pritiska sa sušačem zraka, 3) Četvorokružni zaštitni ventil, 4, 5) Rezervoar za zrak, 9) Kočni ventil motornog vozila, 16) Tristop cilindar, 21) Spojnička glava za napajanje

Source: WABCO Vehicle Control Systems - An American Standard Company

<sup>2</sup> Classification of vehicles in accordance with ECE Rulebooks:  
 N<sub>3</sub> – vehicles for transport of load, whose maximum total mass exceeds 12.000 kg.  
 O<sub>3</sub> – trailers with maximum total mass exceeds 3.500 kg and does not exceed 10.000 kg.



**Figure 3.** Dual air braking system for three-axle semi-trailers with ABS (4S/3M): 39) Head of coupler, 45) Tanks for air  
**Slika 3.** Dvodvodni pneumatski sistem kočenja za troosovinsku poluprikolicu sa ABS-om (4S/3M) 39) Spojnička glava, 45) Rezervoar za zrak

Source: WABCO Vehicle Control Systems - An American Standard Company

Compressed air enters the four-circuit protection valve, position 3, whose main task is, in case of a sudden fall in pressure in one of these for circuits, to prevent a drop in pressure in other circuits. From the four-circuit protection valve, compressed air flows through connections into corresponding tanks, positions 4, 5 and 45. Compressed air from tanks I and II is led toward the braking valve of a motor vehicle, position 9, while compressed air from tank III is led to the coupler head for supply, position 21, and Tristop cylinders, position 16. Compressed air from tank IV is used for supplying of auxiliary consumers. In case a trailer is attached (Figure 3), compressed air is led through the coupled head for supply, position 39, to the tank, position 45.

Thus, the objective of the tank is to preserve compressed air produced in the compressor. Tanks are relatively simple constructions and the quality of the braking system depends on their dimensions and manner of construction and installation. A tank consists of a cylindrical shell of circular cross section closed by outwardly dished and/or flat ends, with coil extensions for connecting of pipelines and slit for releasing of condenser. Capacity of the tank and value of the pressure

inside the tank are different depending on the type and purpose of the vehicle.

For instance, for the system shown in Figures 2 and 3, for all air tank sizes of capacity below 60 liters, working pressures are higher than 10 bar. Another example is a braking system with compressed air for agricultural vehicles, where compressed air from the compressor flows over the pressure regulator, which regulates pressure in the scope of 13.3 - 14 bars, in the tank with the capacity of 20 liters.

Because of the above-mentioned and because of the perception on potential dangers that can be caused by air braking systems, braking tanks of motor vehicles and their trailers fall into the category of products that require harmonization of national legislations, which remove technical barriers on the European market and protect the market from insecure and dangerous products. Before a product (tank) is commercially available and can be distributed without limitations within the EU, a CE mark has to be awarded to the product, which includes a CE mark which symbolizes harmonization with the Directive 87/404EEC, meaning harmonized standard EN 286-2.

### 3. Structure and Technical Requirements of EN 286-2 Standard

Harmonized standard EN 286-2 applies to the design and manufacture of simple unfired serially made pressure

vessels designed for air braking equipment and auxiliary systems for motor vehicles and their trailers.

Vessel manufactures in accordance with this standard work under limitations given in Table 2.

**Table 2.** Scope of application and structure of standard EN 286-2

**Tablica 2.** Područje primjene i struktura standarda EN 286-2

Geometry of vessel / Geometrija posude	A cylindrical shell of circular cross-section, closed by outwardly dished and/or flat ends which have branches not larger in diameter than 0,5 of the diameter of the cylinder to which they are welded / Cilindrični plašt kružnog poprečnog presjeka, izvana zatvoren ispupčenim ili ravnim dancadima, sa priključcima promjera manjim od polovine promjera cilindra na koji se zavaruje
Fabrication / Postupak spajanja	Welding / Zavarivanje
Internal pressure / Unutrašnji pritisak	greater than/ iznad 0,5 bar
Working pressure / radni pritisak PS	maximum / ispod 30 bar
Capacity / Zapremina	not exceeding / ispod 150 liters
Product of pressure and the capacity / Proizvod pritiska i zapremine	$50 \leq PSV \leq 1.500$ bar liters
Working temperature / Radna temperatura	$- 50 \text{ }^{\circ}\text{C} \leq T \leq 100 \text{ }^{\circ}\text{C}$
Materials of the main pressurized parts <sup>3</sup> / Materijali glavnih dijelova pod pritiskom <sup>3</sup>	Steel vessels: plate, strip and bar according to EN 10027: SPH 235, SPH 265 and SPHL 275; tubes according to ISO 2604: part 2 (grades TS5 and TS9) and ISO 2604:Part 3 (grades TW5 and TW9); forgings according to ISO 2604: Part 1 (grade F9) Aluminum vessels: Al, AlMg, AlMn, AlMgMn / Čelične posude: lim, traka i šipka po EN 10027: SPH 235, SPH 265 i SPHL 275; cijevi po ISO 2604: Dio 2 (vrsta TS% i TS9) i ISO 2604: Dio 3 (vrste TW5 i TW9); otkivci po ISO 2604: Dio 1 (vrsta F9) Aluminijske posude: Al, AlMg, AlMn, AlMgMn
Additional materials and welding consumables on or off vessel / Materijali dodatka na posudi i materijali za zavarivanje	All additional materials, non pressurized parts and welding consumables used to manufacture the welds on or off vessel shall be appropriate to and compatible with the materials to be welded / Svi dodaci na posudi, dijelovi posude koji nisu opterećeni pritiskom i dodatni i pomoćni materijali za zavarivanje moraju biti kompatibilni sa materijalima koji se zavaruju
Determination of the wall thickness / Određivanje debljine zida posude	<ul style="list-style-type: none"> <li>- Calculation method / Metoda proračuna</li> <li>- Experimentation method / Eksperimentalna metoda</li> </ul>
Actual wall thickness / Stvarna debljina zida posude, $e_a$	<ul style="list-style-type: none"> <li>- For steel vessels / Za čelične posude: <math>e_a \geq 2</math> mm</li> <li>- For vessels made of Al and Al alloys / Za posude od Al i Al legura: <math>e_a \geq 3</math> mm</li> </ul>
Construction and fabrication of vessel / Dizajn i proizvodnja posude	Responsibilities of manufacturer / Odgovornost proizvođača: <ul style="list-style-type: none"> <li>- Providing all measures for ensuring of quality of construction and fabrication / Mjere za osiguranje kvaliteta izrade i dizajna,</li> <li>- Providing of specialists for production and own competent supervisory personnel / Osiguranje specijalista za proizvodnju kao i vlastitog kompetentnog osoblja za nadzor</li> </ul>
Qualification of welders, welding operators and welding inspectors / Kvalifikacija zavarivača, operatera i inspektora zavarivanja	Testing and approval of welders and welding operators shall be in accordance with EN 287, Part 1 and Part 2 / Ispitivanje i potvrđivanje kvalifikacije: prema EN 287, Dio 1 i Dio 2

<sup>3</sup> Material must be accompanied by a testing certificate from an approved inspection body, which is to verify that the material is suitable and harmonized with the essential security requirements regulated by the Directive 87/404/EEC.

<p>Qualification of welding procedures and requirements / Kvalifikacija procedura zavarivanja i zahtjevi prihvatljivosti</p>	<p>The suitability of the welding procedure shall be established in accordance with EN 288: Part 1 / Kvalifikacija procedura zavarivanja i zahtjevi prihvatljivosti  Qualification tests for steel according to EN 288, Part 3 / Test kvalifikacije za čelike: prema EN 288, Dio 3  Qualification tests for aluminum and aluminum alloys according to EN 288, Part 4 / Test kvalifikacije za Al i Al legure: prema EN288, Dio 4  Requirements / Zahtjevi prihvatljivosti:  Welded joints on steel / Zavareni spojevi na čeliku:  <ul style="list-style-type: none"> <li>- Tensile test transverse to weld: <math>\geq</math> Tensile test of base metal / Zatezna čvrstoća zavarenosti: <math>\geq</math> zateznoj čvrstoći osnovnog materijala</li> <li>- Notch bar impact test / Žilavost, KV, for <math>e_a &gt; 5</math> mm and <math>T_{min} \leq -10</math> °C: <math>\geq 28</math> J</li> <li>- Bend test: 180 °C, without open defects in any direction greater than 3 mm / Savijanje: 180 °C, bez otvorenih defekata iznad 3 mm</li> <li>- Non-destructive examination: in accordance with EN 25817 level B / Ispitivanje bez razaranja: prema EN 25817 nivo B</li> <li>- Visual examination: in accordance with EN 25817 level B / Vizualno ispitivanje: prema EN 25817 nivo B</li> </ul> Welded joints on aluminum / Zavareni spojevi na aluminijumu:  <ul style="list-style-type: none"> <li>- Tensile test transverse to weld: <math>\geq</math> Tensile test of base metal / Zatezna čvrstoća zavara: <math>\geq</math> zateznoj čvrstoći osnovnog materijala</li> <li>- Bend test: 180 °C, without open defects in any direction greater than 3 mm, in accordance with EN288, Part 4 / - Savijanje: 180 °C, bez otvorenih defekata iznad 3 mm, prema EN288, Dio 4</li> <li>- Non-destructive examination: in accordance with ISO 10042 level B / Ispitivanje bez razaranja: prema ISO 10042 nivo B</li> </ul> Visual examination: in accordance with ISO 10042 level B / Vizualno ispitivanje: prema ISO 10042 nivo B</p>
<p>Resistance to corrosion / Otpornost na koroziju</p>	<p>Steel vessels: Inside and outside protection test to be carried out once per 10.000 vessels or per six months, whichever comes first, or when changing the coating procedure, in accordance with ISO 2409 and ISO 7253. / Čelične posude: 1 ispitivanje unutrašnje i vanjske zaštite na 10.000 posuda ili nakon 6 mjeseci ili kod promjene premaza, prema ISO 2409 i ISO 7253  Aluminum vessels: Protection against corrosion is not required / Aluminijske posude: ne zahtijeva se zaštita od korozije</p>
<p>Tests and certificates prior to production / Ispitivanja i certifikati prije početka proizvodnje posuda</p>	<p>For <math>50 &lt; PSV \leq 1.500</math>:  <ul style="list-style-type: none"> <li>- Certificate of adequacy of the design and manufacturing, or / certifikat o adekvatnosti plana dizajna i proizvodnje ili</li> <li>- type examination / ispitivanje tipa</li> </ul> </p>
<p>Tests and certificates prior to vessels being placed on the market / Ispitivanja i certifikati prije plasiranja posuda na tržište</p>	<p>For <math>50 &lt; PSV \leq 200</math>: declaration of conformity or verification / Za <math>50 &lt; PSV \leq 200</math>: deklaracija o usklađenosti ili verifikacija  For <math>200 &lt; PSV \leq 1.500</math>: declaration of conformity and surveillance or verification / Za <math>200 &lt; PSV \leq 1500</math>: deklaracija o usklađenosti i nadzor ili verifikacija</p>
<p>Tests to be carried out during manufacture / Ispitivanja koja se provode tijekom proizvodnje</p>	<p>All production vessels: 100 % visual examination, acceptance levels in accordance with EN 26520 / Za sve proizvedene posude: vizualno ispitivanje 100 % , nivo prihvatanja prema EN 26520;  For vessels designed by the calculation method / Za posude dizajnirane metodom proračuna:  <ul style="list-style-type: none"> <li>- test of welds, or / ispitivanje zavara ili</li> <li>- burst tests / ispitivanje pritiskom do loma</li> </ul> For vessels designed by the experimental method / Za posude dizajnirane metodom eksperimenta:  <ul style="list-style-type: none"> <li>- hydraulic pressure test followed by a burst test / hidraulično ispitivanje pritiskom, za kojim slijedi ispitivanje pritiskom do loma</li> </ul> </p>
<p>Pressure test / Ispitivanje pritiskom</p>	<p>Hydraulic or pneumatic tests for each vessels / Hidraulično ili pneumatsko ispitivanje svake posude</p>
<p>Marking of vessel / Obilježavanje posude</p>	<p>The vessels or data plate shall bear at least the following information: PS, <math>T_{max}</math>, <math>T_{min}</math>, V, the name or mark of the manufacturer, the type and serial or batch identification of the vessel and year of manufacture, CE mark, standard EN 286-2:1992 / Posuda ili natpisna ploča mora sadržavati sljedeće podatke: PS, <math>T_{max}</math>, <math>T_{min}</math>, V, oznaku proizvođača, identifikaciju grupe posude i god. proizvodnje, CE znak, standard EN 286-2:1992</p>
<p>Documentation to accompany the vessel to be presented to the user / Prateća dokumentacija uz posudu koja se prezentira korisniku</p>	<p>Documentation shall include: information on purpose of the vessel, in compliance with EN 286-2, particulars on the vessel, declaration of conformity, approval number, installation requirements, maintenance requirements, information that there shall be welding operation or heat treatment on pressurized parts of the vessel / Dokumentacija uključuje: informaciju o namjeni posude prema EN 286-2, podaci o posudi, deklaraciju o usklađenosti, broj odobrenja, instalacijski zahtjevi, zahtjevi za održavanje, informaciju o zabrani naknadnog zavarivanja i termičke obrade na dijelovima posude koji su pod pritiskom</p>

#### 4. Conformity Assessment Procedure for Tanks in accordance with EN 286-2

The tests carried out as part of the procedure of conformity assessment for air braking tanks systems, in accordance with EN 286-2 (for  $50 < PSV \leq 1500$ ), shown on Figure 4., can be divided into two phases:

- Tests prior to production of tanks, and
- Tests prior to tanks being placed on the market.

Before the start of production of tanks, the manufacturer can chose between:

- a) certificate of adequacy, i.e. approval of design and manufacturing schedule, respectively,
- b) type examination, i.e. conformity testing based on one or more specimens of a product representative of the production.

In case the manufacturer, or his authorized representative, selects option a), an approved inspection body shall submit design and manufacturing schedule, which shall contain: a detailed manufacturing drawing of the tank type, instructions, documents and certificates relating to the suitable materials selected qualification of the welding procedures and of the welders or operators and a specimen of the proposed report on examination and tests.

In case the manufacturer, or his authorized representative, selects option b), an approved inspection body shall submit an application for type examination, which shall contain design and manufacturing schedule and a prototype vessel, meaning a representative of the production envisaged. The approved inspection body shall examine the documents in order to check the conformity of the design, qualifications and tests, and after that it shall also verify that the test sample has been manufactured in conformity with the design and manufacturing schedule and is a representative of the type. The check that the test tank complies with the requirements of this standard included 100 % non destructive testing of main seams and hydrostatic test, after which a type-examination certificate is drawn up.

*Prior to tanks being placed on the market*, tanks manufactured in accordance with this standard or with the approved prototype, at own choice by manufacturer, will be subject to:

- a. For  $50 < PSV \leq 200$  bar l: EC verification or EC declaration of conformity,
- b. For  $200 < PSV \leq 1.500$  bar l: EC verification or EC declaration of conformity and EC surveillance.

Verification is the procedure adopted at the choice of the manufacturer to check and certify that the manufactured tanks comply with this standard, and is conducted by an

inspection body on batches of tanks submitted by their manufacturer or by his authorized representative. Batches shall be accompanied by the type-examination certificate or by the certificate of adequacy. Verification contains a check of the manufacturing record, external and internal inspection, dimensional check and destructive and non-destructive testing. Inspection body shall issue an EC verification certificate.

Declaration of conformity is the procedure whereby the manufacturer certifies tanks with a product  $50 < PSV \leq 1.500$  bar l, to be in conformity with standard EN 286-2, but in the case  $200 < PSV \leq 1.500$ . Manufacturer must additionally provide access to production sites and/or storage to the surveillance body, in order to secure that the manufacturer fully complies with the obligations required by this standard.

Thus, before placing on the market, the authorized inspection body puts the EC mark on the tanks that possess either a verification certificate or declaration on conformity (and surveillance). This is a mark of harmonization which confirms that the serially made vessels comply with the EN 286-2 standard or an approved prototype.

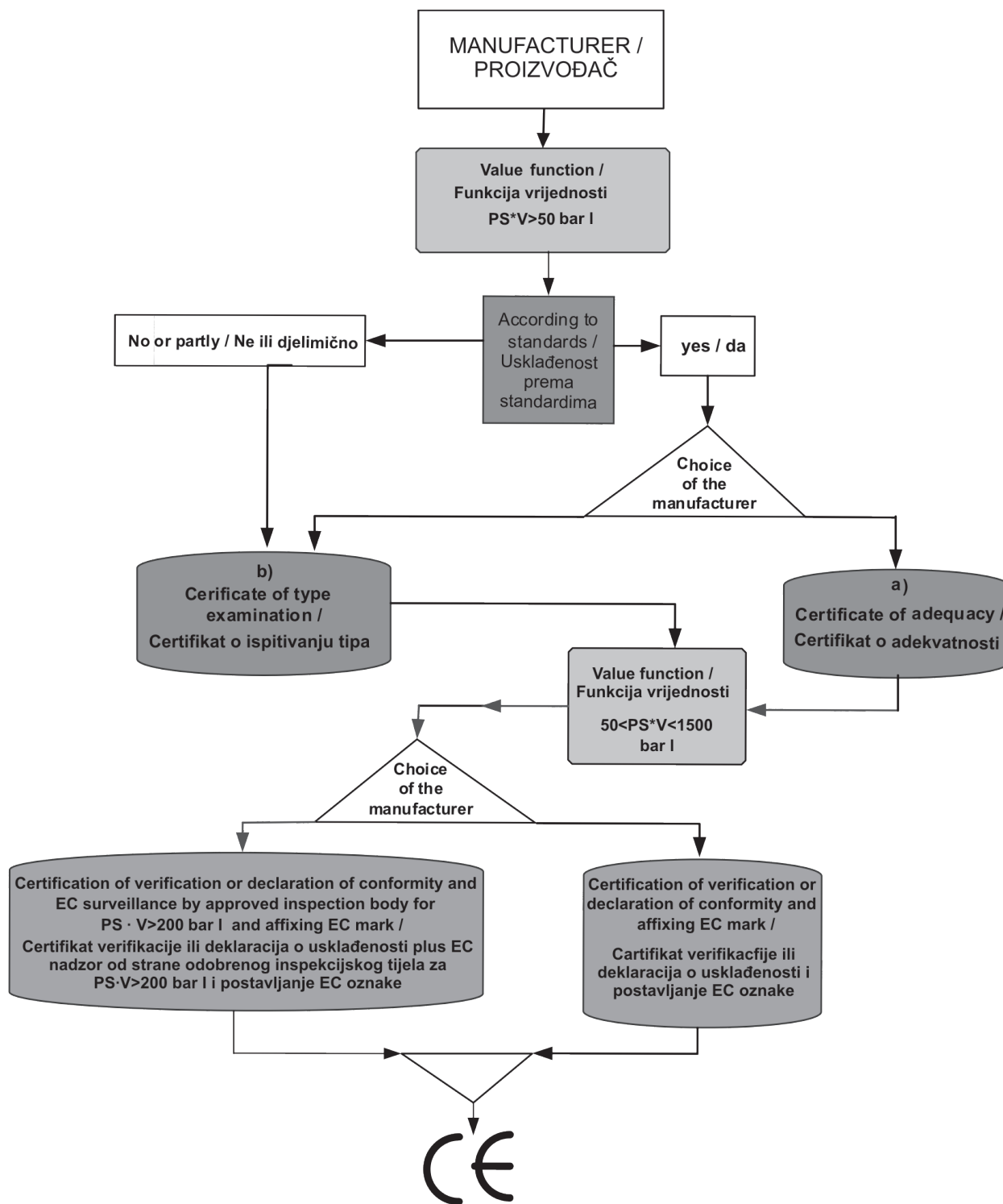
EC mark consists of a symbol CE, last two number of the year in which the mark was put and an identification number of the authorized body responsible for conducting the certification procedure. Beside a defined EC mark, the tank or the data plate must include information on maximum working pressure, temperature, capacity of the vessel, name of manufacturer and identification of the type and series of the vessel. The data plate must provide free space for entry of other necessary information.

#### 5. Conclusion

Air braking tanks for motor vehicles and their trailers are pressurized vessels that pose a security risk in the state of rest as well as during exploitation. The standardization and harmonization of technical regulations in this field in Europe rests on the principle of implementation of the essential security and health requirements, defined within the Directive 87/404/ EEC and harmonized standard EN 286-2, which supports the abovementioned Directive.

Because of that, this paper, through presentation of the structure and practical application of the EN 286-2 standard, presents procedures for assessment of conformity with the abovementioned standard that must be undertaken before tanks are placed on the market.





**Figure 4.** Flow diagram for procedures of conformity assessment for air braking tanks for motor vehicles and their trailers  
**Slika 4.** Dijagram proceduralnog tijeka ocjenjivanja usklađenosti rezervoara zračnog sistema kočenja kod motornih vozila i njihovih prikolica

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