

**Committee of Experts on the Transport of Dangerous Goods
and on the Globally Harmonized System of Classification
and Labelling of Chemicals**

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**Use of the Manual of Tests and Criteria in the
context of the GHS**

**Joint work with the Sub-Committee of Experts on the
Transport of Dangerous Goods (TDG Sub-Committee)**

**Use of the Manual of Tests and Criteria in the context of
GHS**

**Transmitted by the Chairman of the Working Group on Explosives of
the Sub-Committee of Experts on the Transport of Dangerous Goods
(TDG Sub-Committee) on behalf of the Working Group**

1. Document ST/SG/AC.10/C.3/2018/1–ST/SG/AC.10/C.4/2018/1 contains the list of amendments to sections 1 to 10 of the Manual of Tests and Criteria, agreed by the Working Group on Explosives and recommended for adoption by the TDG and GHS sub-committees.
2. This document contains the text of sections 1 and 10 of the sixth revised edition of the Manual of Tests and Criteria, as amended by ST/SG/AC.10/C.3/2018/1–ST/SG/AC.10/C.4/2018/1. All the proposed amendments are indicated: inserted text is shown in blue (*inserted*); deleted text is shown in red, strikethrough (*deleted*).

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SECTION 1

GENERAL INTRODUCTION

NOTE: *This general introduction relates only to Parts I to III of the Manual of Tests and Criteria and its Appendices 1 to 9. At its second session (10 December 2004), the Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals decided to add a new Part IV relating to tests methods concerning transport equipment. At its seventh session, the Committee of Experts on the Transport of Dangerous Goods and the Globally Harmonized System of Classification and Labelling of Chemicals decided to add a new Part V relating to classification procedures, test methods and criteria relating to sectors other than transport.*

1.1 Introduction

1.1.1 The purpose of the Manual of Tests and Criteria (hereafter referred to as the “Manual”) ~~this text~~ is to present the United Nations schemes for the classification of ~~certain types of~~ dangerous goods subject to transport regulations and hazardous substances and mixtures in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals and to give descriptions of the test methods and procedures considered to be the most useful for providing competent authorities and manufacturers and suppliers with the necessary information to arrive at a proper classification ~~of substances and articles for transport~~.

1.1.2 ~~The~~ This Manual ~~of Tests and Criteria~~ should be used in conjunction with the latest versions of:

- (a) the Recommendations on the Transport of Dangerous Goods (hereafter referred to as the Recommendations) and ~~of the~~ Model Regulations ~~on the Transport of Dangerous Goods~~ annexed ~~thereto~~ ~~these Recommendations~~ (hereafter referred to as the Model Regulations) and;
- (b) the Globally Harmonized System of Classification and Labelling of Chemicals (hereafter referred to as the GHS).

1.1.3 Definitions of terms used in the Manual may be found in Chapter 1.2 and Annex B of the Model Regulations and in the GHS. The term substance as it is used in this Manual includes substances, mixtures and solutions, unless otherwise stated.

1.1.4 The test methods and criteria in this Manual were originally developed to address classification for transport purposes, and therefore in previous editions of the Manual (up to the 7th revised edition) frequent reference is made to “as packaged for transport”. As for physical hazards the GHS refers to the tests contained in this Manual, to facilitate its use in the context of the GHS (i.e.: in sectors other than transport), the phrase “as offered for classification” is now used instead when appropriate. For example, if the classification to be determined is for products as packaged for transport, “as offered for classification” means “as offered for transport”. On the other hand, if the classification to be determined is for sectors other than transport in the context of the GHS, then “as offered for classification” means “in the condition relevant to the particular application, e.g. supply and use”. More details on the reasons for this change are provided below.

1.1.5 The outcome of the tests in this Manual is predominantly related to the intrinsic properties of the substance being tested. However the test results may also be affected by other physical parameters such as: density; particle size (distribution) and humidity. For some physical hazards the outcome of the tests and hence the classification can also be dependent on the quantity of the sample and the packaging.

1.1.6 For these reasons, the above mentioned parameters and circumstances should be taken into account when considering test results, particularly for classification for sectors other than transport.

1.1.7 It should be noted that the Manual ~~of Tests and Criteria~~ is not a concise formulation of testing procedures that will unerringly lead to a proper classification ~~of products~~. It therefore assumes technical competence on the part of the testing body. ~~The~~ Where appropriate, the competent authority has discretion to dispense with certain

tests, to vary the details of tests, and to require additional tests when this is justified to obtain a reliable and realistic assessment of the hazard of a product. In some cases, a small scale screening procedure may be used to decide whether or not it is necessary to perform larger scale classification tests. Suitable examples of procedures are given in the introductions to some test series and in Appendix 6. Examples which may be listed within various test procedures are for illustrative purposes and are provided for guidance only.

1.1.8³ In situations where the proper classification of substances and articles of certain hazard classes ~~or Divisions for transport~~ is the responsibility of the Competent Authority, it is normal and accepted practice that due consideration will be given to testing or classification results of other Competent Authorities when provided.

1.1.9 The text and references throughout the manual strive to be sector-neutral, but sometimes must be sector-specific. For example, Part IV is used for transport equipment, and Part V is used for sectors other than transport. Also, there is some sector-specificity within Parts I and II describing tests with packages as presented for transport. Explosives transport classifications to the Division level frequently apply only to a defined configuration, with the quantity and confinement (packaging) as prepared for transport. Sectors other than transport may build upon explosives transport classifications.

1.2 Hazard classes in the Model Regulations and in the GHS

1.2.1 Hazard classes in the Model Regulations

1.2.1.1 Substances and articles subject to the Model Regulations are assigned to one of nine classes according to the hazard or the predominant hazard they present for transport. Some of these classes are subdivided into divisions addressing a more specific type of hazard within a given class. The numerical order of the classes and divisions does not reflect the degree of hazard.

1.2.1.2 In addition, for packing purposes, some dangerous goods are assigned to one of three packing groups in accordance with the degree of hazard they present:

- Packing group I: high hazard
- Packing group II: medium hazard
- Packing group III: low hazard

The packing group to which a substance is assigned is indicated in the Dangerous Goods List in Chapter 3.2 of the Model Regulations. Articles are not assigned to packing groups.

1.2.1.3 Dangerous goods meeting the criteria of more than one hazard class or division and which are not listed in the Dangerous Goods List are assigned to a transport class and division and subsidiary hazard(s) on the basis of the precedence of hazards characteristics.

1.2.1.4 Precedence of hazard characteristics for transport purposes

1.2.1.4.1 The precedence of hazard characteristics table in 2.0.3.3 of Chapter 2.0 of the Model Regulations may be used as a guide in determining the class of a substance having more than one hazard, when it is not named in the Dangerous Goods List in Chapter 3.2 of the Model Regulations. For goods having multiple hazards, which are not specifically listed by name in the Dangerous Goods List, the most stringent packing group denoted to the respective hazard of the goods takes precedence over other packing groups, irrespective of the precedence of hazard characteristics table.

1.2.1.4.2 The precedence of hazard characteristics of the following are not dealt with in the Precedence of hazard table in Chapter 2.0 of the Model Regulations, since these primary characteristics always take precedence:

- Substances and articles of Class 1;
- Gases of Class 2;

Liquid desensitized explosives of Class 3;
Self-reactive substances and solid desensitized explosives of Division 4.1;
Pyrophoric substances of Division 4.2;
Substances of Division 5.2;
Substances of Division 6.1 with a packing group I inhalation toxicity;
Substances of Division 6.2; and
Radioactive material of Class 7.

1.2.1.4.3 Self-reactive substances, except for type G, giving a positive result in the self-heating test N.4, should not be classified as pyrophoric liquids or solids but as self-reactive substances (see Chapter 2.4, paragraph 2.4.2.3.1.1 of the Model Regulations). Organic peroxides of type G having properties of another hazard class (e.g. UN No.3149) should be classified according to the requirements of that hazard class.

1.2.2 Hazard classes in the GHS

The GHS addresses classification of substances by types of chemical hazards (e.g. flammability, toxicity, corrosivity) grouped into physical, health and environmental hazards. Each GHS hazard class corresponds to a type of hazard, and it is sometimes specific to a certain aggregation state (solid, liquid or gaseous). Most of the GHS hazard classes are further subdivided into hazard categories reflecting the severity of the hazard, with Category 1 indicating the most severe hazard.

1.2.3 Relationship between the Model Regulations and the GHS

1.2.3.1 Since the GHS addresses other sectors in addition to transport (e.g. storage, supply and use), it includes hazards not considered relevant to transport, such as several non-acute health hazards. Due to the differences in scope between the GHS and the Model Regulations not all hazards addressed in the GHS have their counterparts in the Model Regulations, and vice versa. For instance there is no specific hazard class in the GHS for radioactive material (Class 7 in transport) and some of the dangerous goods classified for transport in Class 9 are covered by other GHS hazard classes (e.g.: environmentally hazardous substances of Class 9 may fall under the GHS hazard class Hazardous to the aquatic environment).

1.2.3.2 In addition, while one transport class may cover several different types of hazards, GHS hazard classes usually address one type of hazard each. For instance, substances of Class 4 in transport belong to seven individual GHS hazard classes. Furthermore, while transport classes are identified by a number (1 to 9), GHS hazard classes are identified by a name reflecting the type of chemical hazard (e.g. “Flammable solids”). Moreover, the concept of precedence of hazards as defined in the Model Regulations (see 1.2.1.4) does not exist in the GHS.

1.2.3.3 The overarching correlation between GHS hazard classes and the transport classes addressed in the Model Regulations is indicated in Table 1.1. The table is indicative only and is not intended to be used as the sole basis in translating the classification of any substance or article between the GHS and the Model Regulations, or vice versa.

TABLE 1.1: CORRELATION BETWEEN HAZARD CLASSES IN THE GHS AND IN THE MODEL REGULATIONS

Hazard classes in the GHS	Hazard classes in the Model Regulations
Explosives, Divisions 1.1 to 1.6	Class 1, Divisions 1.1 to 1.6
Flammable gases, Category 1	Class 2, Division 2.1
Aerosols	Class 2, Division 2.1 and 2.2
Oxidizing gases	Class 2, Division 2.2 with subsidiary hazard 5.1
Gases under pressure	Class 2
Flammable liquids, category 1 to 3	Class 3
Flammable solids	Class 4, Division 4.1
Self-reactive substances and mixtures	Class 4, Division 4.1

Hazard classes in the GHS	Hazard classes in the Model Regulations
Pyrophoric liquids	Class 4, Division 4.2
Pyrophoric solids	Class 4, Division 4.2
Self-heating substances and mixtures	Class 4, Division 4.2
Substances and mixtures which, in contact with water, emit flammable gases	Class 4, Division 4.3
Oxidizing liquids	Class 5, Division 5.1
Oxidizing solids	Class 5, Division 5.1
Organic peroxides	Class 5, Division 5.2
Corrosive to metals	Class 8
Desensitized explosives	Class 3 (liquids) Class 4, Division 4.1 (solids)
Acute toxicity, Categories 1, 2 and 3	Class 6, Division 6.1 (solids and liquids) Class 2, Division 2.3 (gases)
Skin corrosion, Category 1	Class 8
Hazardous to the aquatic environment, Acute 1 and Chronic 1 and 2	Class 9 (environmentally hazardous substances)

1.3.2 Layout

1.3.2.1 The ~~classification procedures, test methods and criteria are~~ Manual is divided into ~~three~~ five parts:

Part I: ~~those~~ relating to ~~assignment of~~ explosives ~~to Class 1~~;

Part II: ~~those~~ relating to ~~assignment of~~ self-reactive substances ~~to Division 4.1~~ and ~~of~~ to organic peroxides ~~to Division 5.2~~;

Part III: ~~those~~ relating to ~~assignment of substances or articles to Class 2, Class 3, Class 4, Division 5.1, Class 8 or Class 9~~ aerosols, desensitized explosives (relating to transport only), flammable liquids, flammable solids, pyrophoric liquids and solids, substances which in contact with water emit flammable gases, oxidizing liquids and solids, chemically unstable gases and gas mixtures, substances corrosive to metals, and substances and articles of transport Class 9 (ammonium nitrate fertilizers, lithium metal and lithium ion batteries) and solid ammonium nitrate based fertilizers;

Part IV: test methods concerning transport equipment; and

Part V: classification procedures, test methods and criteria relating to sectors other than transport.

~~Part III contains some classification procedures, test methods and criteria which are also given in the Model Regulations.~~

1.3.2 There are also ~~a number of~~ appendices which give information common to a number of different types of tests, on the national contacts for test details, on an example method for emergency relief vent sizing of portable tanks for ~~the transport of~~ organic peroxides and self-reactive substances, ~~and~~ on screening procedures, on flash compositions tests for the classification of fireworks, response descriptors and the ballistic energy test for cartridges, small arms.

1.2.23.3 The methods of test identification are given in Table 1.42.

Table 1.12: TEST IDENTIFICATION CODES

Part of Manual	Test series	Test type	Test number	Example of test identification code
I	1 - 8	(a), (b), etc.	(i), (ii), etc. ^a	2 (a) (i)
II	A - H	-	1, 2, etc.	A.1
III	C, L – TU	-	1, 2, etc.	L1

^a If only one test is given for a test type, the Roman numerals are not used.

1.2.3.4 Each test is given a unique identification code and is edited as follows:

- x.1 Introduction
- x.2 Apparatus and materials
- x.3 Procedure (including observations to be made and data to be collected)
- x.4 Test criteria and method of assessing results
- x.5 Examples of results

NOTE: Examples of results are not normally given for tests on articles as these are too specific to the article tested and do not allow validation of the test procedure. Results on substances may vary from those given in the "Examples of results" if the physical form, composition, purity etc. of the substance is different. The results given should not be regarded as standard values.

Figures x.1, x.2, x.3 etc. (i.e. diagrams of apparatus etc.)

NOTE: Unless otherwise indicated, the dimensions given on the diagrams are in millimetres.

~~1.3 — Precedence of hazard characteristics~~

~~1.3.1 — The table in 2.0.3.3 of Chapter 2.0 of the Model Regulations may be used as a guide in determining the class of a substance, mixture or solution having more than one hazard, when it is not named in the Dangerous Goods List in Chapter 3.2 of the Model Regulations. For goods having multiple hazards, which are not specifically listed by name in Chapter 3.2 of the Model Regulations, the most stringent packing group denoted to the respective hazard of the goods takes precedence over other packing groups, irrespective of the precedence of hazard table in 2.0.3.3 of Chapter 2.0 of the Model Regulations.~~

~~1.3.2 — The precedence of hazard characteristics of the following are not dealt with in the Precedence of Hazard Table in Chapter 2.0 of the Model Regulations, since these primary characteristics always take precedence:~~

- ~~— Substances and articles of Class 1;~~
- ~~— Gases of Class 2;~~
- ~~— Liquid desensitized explosives of Class 3;~~
- ~~— Self-reactive substances and solid desensitized explosives of Division 4.1;~~
- ~~— Pyrophoric substances of Division 4.2;~~
- ~~— Substances of Division 5.2;~~
- ~~— Substances of Division 6.1 with a packing group I inhalation toxicity;~~
- ~~— Substances of Division 6.2; and~~
- ~~— Material of Class 7.~~

~~1.3.3 — Self-reactive substances, except for type G, giving a positive result in the self-heating test for Division 4.2, should not be classified in Division 4.2 but in Division 4.1 (see paragraph 2.4.2.3.1.1 of the Model Regulations).~~

~~Organic peroxides of type G having properties of another class or division (e.g. UN 3149) should be classified according to the requirements of that class or division.~~

1.4 Safety

1.4.1 For the safety of laboratory personnel, the producer or other applicant for classification of a new product should provide all available safety data on the product e.g. the toxicity data (see Chapter 1.5 and Annex 4 of the GHS for guidance on the preparation of Safety Data Sheets).

1.4.2 Particularly when explosive properties are suspected, it is essential for the safety of workers that small scale preliminary tests are carried out before attempting to handle larger quantities. This involves tests for determining the sensitiveness of the substance to mechanical stimuli (impact and friction), and to heat and flame.

1.4.3 In tests involving initiation of potentially explosive substances or articles, a safe waiting period, prescribed by the test agency, should be observed after initiation.

1.4.4 Extra care should be taken when handling samples which have been tested since changes may have occurred rendering the substance more sensitive or unstable. Tested samples should be destroyed as soon as possible after the test.

1.5 General conditions for testing

1.5.1 The conditions given in the test prescriptions should be followed as closely as possible. If a parameter is not specified in the test prescription then the conditions given ~~here below~~ should be applied. Where tolerances are not specified in the test prescription, it is implied that the accuracy is according to the number of decimal places given in any dimension e.g. 1.1 implies 1.05 to 1.15. In cases where conditions during a test deviate from those prescribed, ~~the deviation should be described and~~ the reason for the deviation should be stated in the report.

1.5.2 The composition of the test sample should be ~~representative of the substances being classified. as close as possible to the concentration of the substance intended for transport~~. The contents of active substance(s) and diluent(s) should be specified in the test report with at least an accuracy of $\pm 2\%$ by mass. Components which can have a major effect on a test result, such as moisture, should be specified as accurately as possible in the test report.

1.5.3 All test materials in contact with the test substance should be such that, as far as possible, they do not affect the test results e.g. catalyse decomposition. In cases where such an effect cannot be excluded, special precautions should be taken to prevent the result being affected, e.g. passivation. The precautions taken should be specified in the test report.

1.5.4 The tests should be performed under the conditions (temperature, density etc.) which are representative of the expected circumstances, e.g. of transport ~~or storage~~. If ~~these circumstances transport conditions~~ are not covered by the test conditions specified, supplementary tests may need to be performed which are specifically designed for the anticipated ~~transport~~ conditions, e.g. elevated temperature. Where appropriate, e.g. when the result is particle size dependent, the physical conditions should be specified in the test report.

1.6 Recommended tests

1.6.1 The Manual gives descriptions of tests and criteria used to provide the necessary information to arrive at a proper classification. In some cases, there is more than one test for a particular property. As a result of comparative work with some of these tests, it has been possible to identify one test as the recommended test in a set of equivalent tests. The recommended tests for classifying explosive substances and articles (Part I of the Manual) are listed in Table 1.23 and for classifying self-reactive substances and organic peroxides (Part II of the Manual) in Table 1.34. Unless otherwise specified, all test methods given in Part III of the Manual are recommended tests ~~as only one test is given for each property~~. The other tests in a set are considered to be alternative tests and may continue to be used for classification purposes.

1.6.2 As a result of comparative work, some tests have been deleted. However, as some countries maintain databases referenced by the test number, the tests currently given in the Manual have not been renumbered unless existing tests have been assigned to different test types.

1.6.3 The aim is to have only one United Nations test, or combination of tests, for each property. However, until the recommended tests have been used more widely, it is not possible to do this in all cases at present.

1.6.4 If new tests are proposed for inclusion in the Manual, the proposer should be able to provide justification that the new test is a significant improvement on the existing recommended test. In such cases, the new test may be included as an alternative test until it has been tried by laboratories of other countries.

Table 1.23: RECOMMENDED TESTS ~~FOR EXPLOSIVES AND EXPLOSIVE ARTICLES~~ IN PART I

Test series	Test type	Test code	Test name
1	(a)	1 (a)	UN gap test
1	(b)	1 (b)	Koenen test
1	(c)	1 (c) (i)	Time / pressure test
2	(a)	2 (a)	UN gap test
2	(b)	2 (b)	Koenen test
2	(c)	2 (c) (i)	Time / pressure test
3	(a)	3 (a) (ii)	BAM Fallhammer
3	(b)	3 (b) (i)	BAM Friction apparatus
3	(c)	3 (c) (i)	Thermal stability test at 75 °C
3	(d)	3 (d)	Small-scale burning test
4	(a)	4 (a)	Thermal stability test for unpackaged articles and packaged articles
4	(b)	4 (b) (i)	Steel tube drop test for liquids
4	(b)	4 (b) (ii)	Twelve metre drop test for unpackaged articles, packaged articles and packaged substances
5	(a)	5 (a)	Cap sensitivity test
5	(b)	5 (b) (ii)	USA DDT test
5	(c)	5 (c)	External fire test for Division 1.5
6	(a)	6 (a)	Single package test
6	(b)	6 (b)	Stack test
6	(c)	6 (c)	External fire (bonfire) test
6	(d)	6 (d)	Unconfined package test
7	(a)	7 (a)	EIS cap test
7	(b)	7 (b)	EIS gap test
7	(c)	7 (c) (ii)	Friability test
7	(d)	7 (d) (i)	EIS bullet impact test
7	(e)	7 (e)	EIS external fire test
7	(f)	7 (f)	EIS slow cook-off test
7	(g)	7 (g)	1.6 article external fire test
7	(h)	7 (h)	1.6 article slow cook-off test
7	(j)	7 (j)	1.6 article bullet impact test
7	(k)	7 (k)	1.6 article stack test
7	(l)	7 (l)	1.6 article (or component) fragment impact test

Test series	Test type	Test code	Test name
8	(a)	8 (a)	Thermal stability test for ANE
8	(b)	8 (b)	ANE gap test
8	(c)	8 (c)	Koenen test
8	(d)	8 (d)	Vented pipe tests ^a

^a These tests are intended for evaluating the suitability for ~~transport~~ containment in portable tanks as an oxidizing substance.

Table 1.34: RECOMMENDED TESTS ~~FOR SELF-REACTIVE SUBSTANCES AND ORGANIC PEROXIDES~~ IN PART II

Test series	Test code	Test name
A	A.6	UN detonation test
B	B.1	Detonation test in package
C	C.1	Time/pressure test
C	C.2	Deflagration test
D	D.1	Deflagration test in the package
E	E.1	Koenen test
E	E.2	Dutch pressure vessel test
F	F.4	Modified Trauzl test
G	G.1	Thermal explosion test in package
H	H.1	United States SADT test (for packages)
H	H.2	Adiabatic storage test (for packages, IBCs and tanks)
H	H.4	Heat accumulation storage test (for packages, IBCs and small tanks)

1.7 Reporting

1.7.1 Classifications for [inclusion in the list of dangerous goods for transport in](#) Chapter 3.2 of the Model Regulations are made on the basis of consideration of data submitted to the Committee by governments, intergovernmental organisations and other international organisations in the form recommended in Figure 1 of the Recommendations. Supplementary data is required for the classification of:

- [Explosives](#) ~~Substances and articles of Class 1~~ (see 10.5);
- Self-reactive substances ~~of Division 4.1~~ (see 20.5); and
- Organic peroxides ~~of Division 5.2~~ (see 20.5).

1.7.2 Where tests are performed on packaged substances or articles, the test report should contain the quantity of substance or number of articles per package and the type and construction of the packaging.

PART I

CLASSIFICATION PROCEDURES, TEST METHODS AND CRITERIA RELATING TO EXPLOSIVES ~~OF CLASS 1~~

CONTENTS OF PART I

NOTE 1: The country or organization of origin of each test method is indicated in brackets after each test name.

NOTE 2: The test method recommended for use with each test type is indicated in **bold** and by an asterisk (see subsection 1.6 of the General Introduction).

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SECTION 10

INTRODUCTION TO PART I

10.1 Purpose

10.1.1 Part I of the Manual presents the United Nations scheme for the classification of explosives. It includes a description of the procedures and test criteria considered to be the most useful for providing ~~competent authorities with~~ the necessary information to arrive at a proper classification of explosive substances and articles ~~for transport~~. It should be used in conjunction with the classification flow charts in figures 10.1, 10.2, 10.3, 10.4 and 10.5, the general conditions for testing in sub-section 1.5 and the appropriate test prescriptions in sections 11 to 18 of this Manual.

10.1.2 ~~Goods of Class 1~~ The GHS class of explosives covers all sectors. Class 1 is a subset of this class and comprises explosives as presented for transport. The class of explosives also includes unstable explosives which are those explosives which are forbidden for transport. Goods of class 1 are assigned to one of the six divisions, depending on the type of hazard they present (see Chapter 2.1, paragraph 2.1.1.4 of the Model Regulations and Chapter 2.1, paragraph 2.1.2 of the GHS), and, for some regulatory purposes (e.g. transport), to one of the thirteen compatibility groups which identify the kinds of explosives ~~substances and articles~~ that are deemed to be compatible. The general scheme for classifying a substance or article which is to be considered for inclusion in ~~the class of explosives Class 1~~ is illustrated in Figure 10.1. The assessment is in two stages. In the first stage, the potential of a substance or article to explode ~~should be~~ is ascertained and its chemical and physical stability and sensitivity, ~~both chemically and physically, shown to be acceptable~~ are also determined. In order to promote uniform assessments by competent authorities, it is recommended that, using the flow chart in Figure 10.2, data from suitable tests is analysed systematically with respect to the appropriate test criteria. If the substance or article is provisionally accepted into ~~the class of explosives Class 1~~, it is then necessary to proceed to the second stage and assign it to the correct division by use of the flow charts ~~of~~ in figures 10.3 and 10.5. With the exception of compatibility groups N and S, for which test data is necessary, assignment to a compatibility group, when appropriate, is usually made without reference to testing. In the case of compatibility group S, the tests may be waived (where appropriate by the competent authority) if classification by analogy is based on test results for a comparable article.

10.1.3 Test Series 4 and 6 are performed as presented for transport. Explosives are unique in that the type of packaging and environment frequently have a decisive effect on the hazard and therefore on the assignment to a particular division (see the Chapter 2.1 of the Model Regulations, introductory note 4). Additional considerations may therefore be necessary when transport classifications are used for other sectors.

10.1.4 The test procedures allow assessment of the hazard of explosive substances and articles so that an appropriate classification ~~for transport~~ can be ~~made~~ assigned. When appropriate this is done by the competent authority.

10.2 Scope

10.2.1 New products which are considered as having explosive properties or are intended to function as explosives should first be considered for inclusion in ~~the class of explosives Class 1~~. For substances such as self-reactive substances ~~of Division 4.1~~ or organic peroxides ~~of Division 5.2~~, refer to Part II of this Manual. In this context a new product is one which, when appropriate in the opinion of the competent authority, involves any of the following:

- (a) A new substance ~~or a combination or mixture of substances~~, intended to function as an explosive or pyrotechnic, which is considered to be significantly different from other ~~combinations or mixtures~~ substances already classified;
- (b) A new substance or article, not intended for explosive use, which has, or is suspected of having, explosive properties ~~(see paragraph 2.1.1.5 of the Model Regulations)~~;

- (c) A new design of article containing an explosive substance or an article containing a new explosive substance ~~or a new combination or mixture of explosive substances~~; or
- (d) A new design of package for an explosive substance or article including a new type of inner packaging or a new arrangement of articles (a relatively minor change to an inner or outer packaging can be critical and can convert a lesser ~~risk~~ hazard into a mass explosion ~~risk~~ hazard).

~~The classification procedure should be undertaken before a new product is offered for transport.~~

10.2.2 The producer, or other applicant for the classification of a new product, should provide adequate information concerning the names and characteristics of all explosive substances in the product and should furnish the results of all relevant tests which have been done.

10.3 Acceptance procedure

10.3.1 General description

10.3.1.1 The acceptance procedure is used to determine whether or not a product as offered for transport is a candidate for the class of explosives ~~Class 1~~. This is decided by determining whether a substance provisionally accepted into the class of explosives ~~for Class 1~~ is either too insensitive for inclusion in this class ~~Class 1~~ or is accepted as an unstable explosive (and considered too dangerous for transport); or whether article(s) or packaged article(s) are accepted as an unstable explosive (and considered too dangerous for transport).

10.3.2 Test types

10.3.2.1 The test methods used for deciding provisional acceptance into the class of explosives ~~Class 1~~ are grouped into four series (Test series ~~numbered~~ 1 to 4), and designed to provide the information necessary to answer the questions in Figure 10.2.

10.3.2.2 The question "~~Does Is it have an explosive substance properties?~~" (box 45, Figure 10.2) is answered on the basis of national and international definitions of an explosive substance and the results of three types of Series 1 tests to assess possible explosive effects. The three types of test used are:

- Type 1 (a): a shock test with defined booster and confinement to determine the ability of the substance to propagate a detonation;
- Type 1 (b): a test to determine the effect of heating under confinement; and
- Type 1 (c): a test to determine the effect of ignition under confinement.

10.3.2.3 Series 2 tests are used to answer the question "Is ~~the substance it~~ too insensitive for acceptance into this class ~~1?~~" (box 67, Figure 10.2). In general the basic apparatus used is the same as that for Test Series 1 but with less stringent criteria, e.g. in the case of gap tests, the gap used is greater than zero. The following three types of test are used:

- Type 2 (a): a shock test with defined initiation system and confinement to determine sensitivity to shock;
- Type 2 (b): a test to determine the effect of heating under confinement; and
- Type 2 (c): a test to determine the effect of ignition under confinement.

Figure 10.1: OVERALL SCHEME OF THE PROCEDURE FOR CLASSIFYING A SUBSTANCE OR ARTICLE IN THE CLASS OF EXPLOSIVES¹

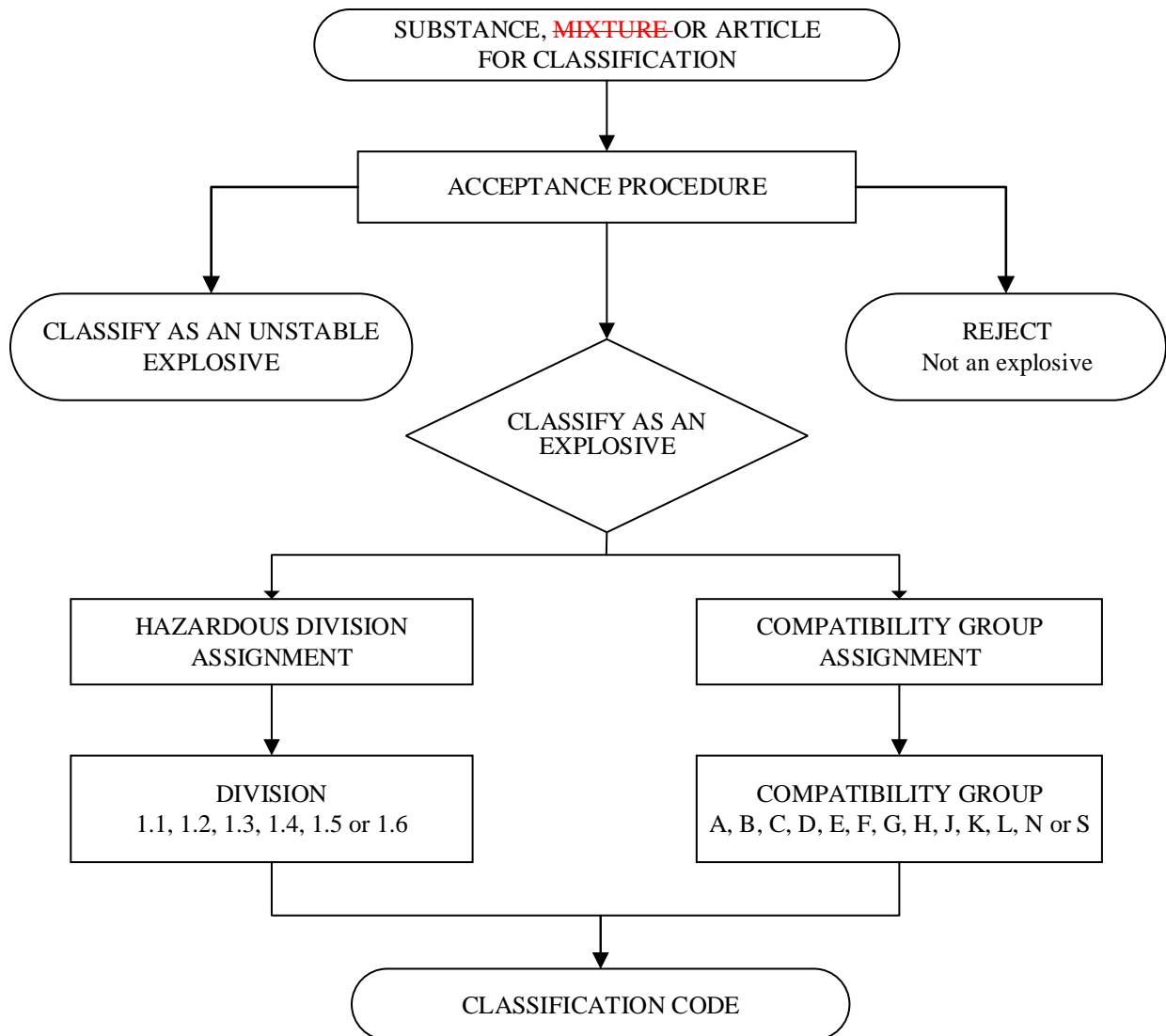
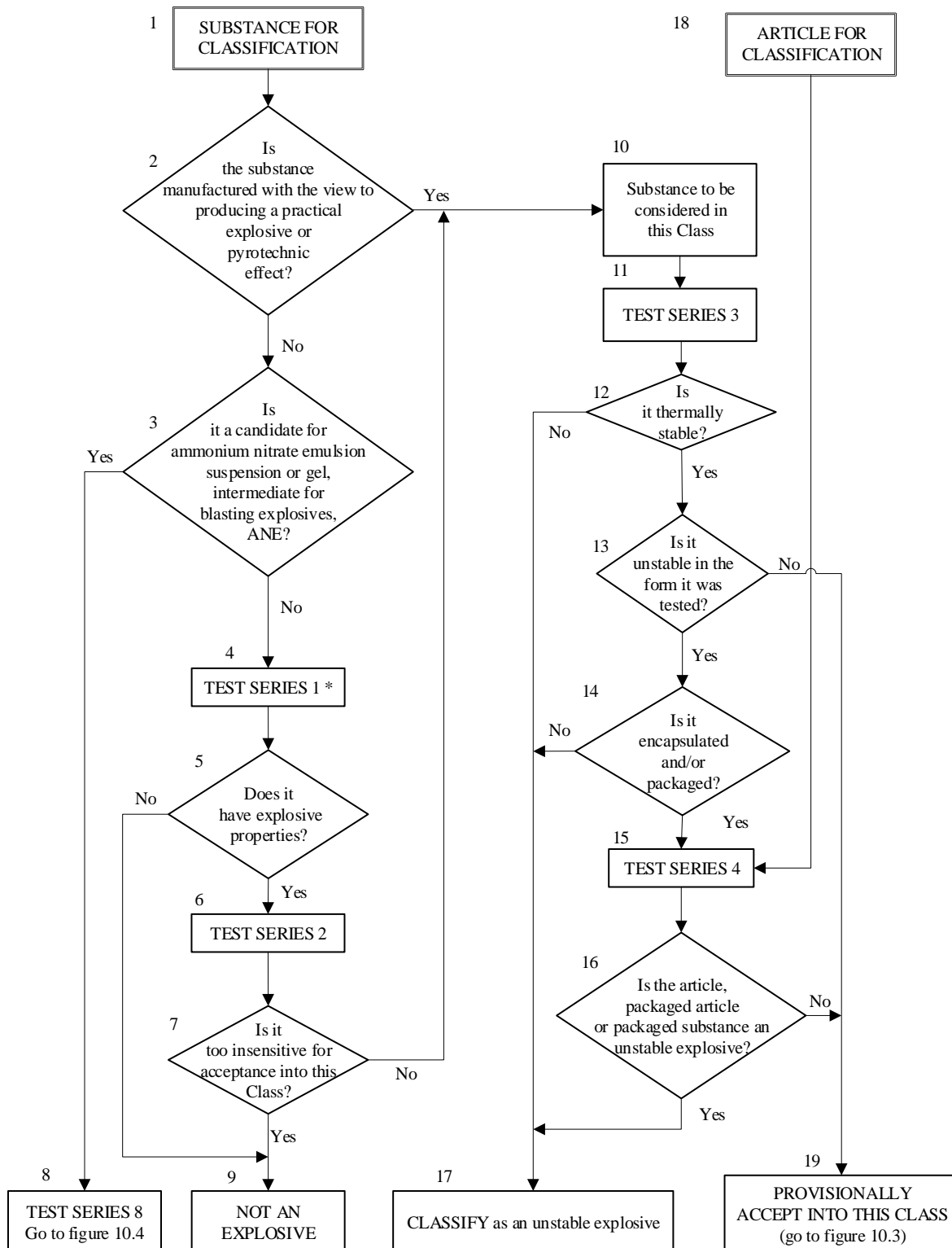


Figure 10.2: PROCEDURE FOR PROVISIONAL ACCEPTANCE OF A SUBSTANCE OR ARTICLE IN THE CLASS OF EXPLOSIVES¹



**/ For classification purposes, start with test series 2*

10.3.2.4 Test series 3 is used to answer the questions "Is it ~~the substance~~ thermally stable?" (box 1240, Figure 10.2) and "Is it ~~unstable the substance too dangerous for transport~~ in the form ~~in which~~ it was tested?" (box 1344, Figure 10.2). This involves tests for determining the sensitiveness of the substance to mechanical stimuli (impact and friction), and to heat and flame. The following four types of test are used:

- Type 3 (a): a falling weight test to determine sensitiveness to impact;
- Type 3 (b): a friction, or impacted friction, test to determine sensitiveness to friction;
- Type 3 (c): an elevated temperature test to determine thermal stability; and
- Type 3 (d): an ignition test to determine the response of a substance to fire.

10.3.2.5 Series 4 tests are intended to answer the question "Is the article, packaged article or packaged substance ~~an unstable explosive too dangerous for transport?~~" (box 16, Figure 10.2). Conditions which may occur during transport include high temperature and high relative humidity, low temperature, vibration, bumping and dropping. The two types of test to be carried out are:

- Type 4 (a): a test of thermal stability for articles; and
- Type 4 (b): a test to determine the hazard from dropping.

10.3.3 *Application of the test methods*

10.3.3.1 The numbering of test series 1 to 4 relates to the sequence of assessing the results rather than the order in which the tests are conducted. ***It may be important for the safety of experimenters that certain preliminary tests, using small amounts of material, be conducted first before proceeding to experiment with larger quantities.*** The results of these preliminary tests may also be used in the classification procedure.

10.3.3.2 The acceptance procedure for substances designed to have a practical explosive or pyrotechnic effect starts with the application of test series 3 to determine if the substance is too sensitive for transport in the form in which it is tested. If the substance passes all tests, the procedure for the assignment to the appropriate division is applied. If the substance fails any of the tests, it is forbidden for transport in the form tested. A substance which fails test type 3 (c) may be altered and resubmitted to test type 3(c). A substance which fails test types 3 (a), 3 (b) or 3 (d) may be encapsulated or packaged to reduce sensitiveness to external stimuli and submitted to test type 4(b).

10.3.3.3 All articles as presented for transport (packaged or unpackaged) should be subjected to test series 4. However, if there is sufficient information to indicate that the article would not be too dangerous for transport, the competent authority, **where appropriate**, may decide to waive all or part of these tests for the article. If the product passes all the required tests in test series 4, the procedure for assignment to the appropriate division is applied. If the product fails any of the required tests, it is forbidden for transport in the form tested, but it may be modified or repackaged and resubmitted to test series 4. If **it is suspected (e.g. by the competent authority where appropriate) suspects** that the product may be subject to stimuli other than those specified in test series 4 resulting in potentially dangerous effects, additional information or tests may be required (see note under paragraph 2.1.3.3.1 of the Model Regulations).

10.3.3.4 ~~Although t~~Test series 1 indicates whether a substance, ~~not designed to have an explosive effect~~, has ~~in fact potentially~~ explosive properties. ~~However, for a new substance not designed to have a practical explosive or pyrotechnic effect, again~~ it is more appropriate to start the testing procedure with test series 3. ~~These tests~~ Test Series 3 involves relatively small sample sizes, which reduces the risk to test personnel. ~~If test series 3 indicates that a substance is too sensitive for transport in the form in which it is tested, then the procedures for reducing its sensitiveness to external stimuli, outlined in 10.3.3.2, should be applied. If test series 3 indicates that the substance passes test series 3 is not too sensitive for transport,~~ as a practical matter the next step is the application of test series 2 which determines whether the substance is too insensitive for inclusion into the class of explosives ~~Class 1~~. There is no real need to perform test series 1 at this point. ~~in the acceptance procedure since test series 2 answers the pertinent question regarding the degree of insensitiveness of the substance. Test series 1 is concerned with the resolution of questions relating to the explosive nature of the substance. The procedure for assignment to a division of Class 1 should be applied to s~~Substances which fail test series 2 but pass test series 3 ~~i.e. they are not too insensitive for acceptance into Class 1 nor are they thermally unstable or too dangerous to transport in the form in which they are tested~~ shall be

subjected to the procedure for assignment to the appropriate division of explosives. It is important to note, however, that a substance which fails test series 2 may still, ~~if properly packaged, leave~~ be excluded from the class of explosives ~~Class 1~~ provided ~~that~~ the substance ~~product~~ is not designed to have a ~~practical explosive or pyrotechnic explosive~~ effect, ~~and does not~~ nor exhibits any ~~explosive-hazardous~~ effects in test series 6 of the assignment procedure as packaged.

10.3.3.5 If articles contain expensive, inert, control components, ~~for testing purposes~~ these may be replaced by inert components having a similar mass and volume.

10.4 Procedure for assignment to a division of ~~Class 1~~ the class of explosives

10.4.1 General description

10.4.1.1 ~~Goods of Class 1~~ Unless classified as unstable, explosives are assigned to one of six divisions, depending on the type of hazard they present (see paragraph 2.1.1.4 of the Model Regulations and 2.1.2 of the GHS). The assignment procedure (figures 10.3 and 10.5) applies to all substances and ~~for~~ articles that are candidates for this class ~~Class 1~~ except those declared from the outset to be in Division 1.1. A substance or article is ~~should be~~ assigned to the division which corresponds to the results of the tests to which it ~~the substance or article, as offered for transport,~~ has been subjected. Other test results, and data assembled from accidents which have occurred, may also be taken into account. As indicated in box ~~39 36~~ of Figure 10.3, there is authority to exclude an article from the class of explosives ~~Class 1~~ by virtue of test results and the “explosives” ~~Class 1~~ definition (see paragraph 2.1.1.1 (b) of the Model Regulations and paragraph 2.1.1.2 (b) of the GHS). Specific criteria by which articles may be excluded from the class of explosives may be found in the Model Regulations (see paragraph 2.1.3.6.4).

10.4.2 Test types

10.4.2.1 The test methods used for assignment to a division are grouped into three series (~~numbered-Test Series 5 to 7~~) designed to provide the information necessary to answer the questions in Figure 10.3. The tests in series 5, 6 and 7 should not be varied unless the ~~competent national~~ authority is prepared to justify such action internationally.

10.4.2.2 The results from three types of series 5 tests are used to answer the question "Is it a very insensitive explosive substance with a mass explosion hazard?" (box ~~28 21~~, Figure 10.3). The test types are:

- Type 5 (a): a shock test to determine the sensitivity to intense mechanical stimulus;
- Type 5 (b): thermal tests to determine the tendency for transition from deflagration to detonation;
and
- Type 5 (c): a test to determine if a substance, when in large quantities, explodes when subjected to a large fire.

Figure 10.3: PROCEDURE FOR ASSIGNMENT TO A DIVISION OF THE CLASS OF EXPLOSIVES 1

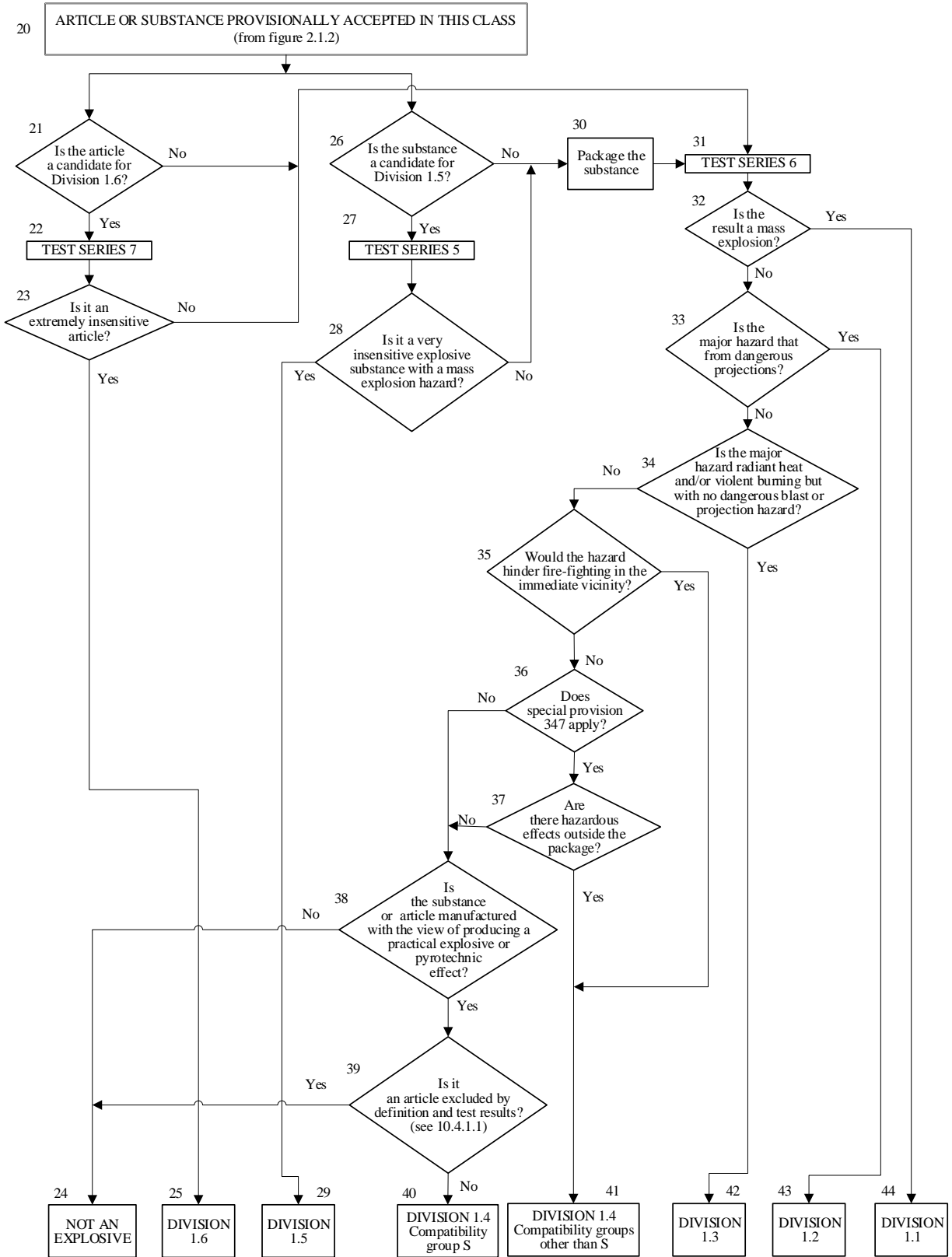


Figure 10.4: PROCEDURE FOR AMMONIUM NITRATE EMULSION, SUSPENSION OR GEL, INTERMEDIATE FOR BLASTING EXPLOSIVES

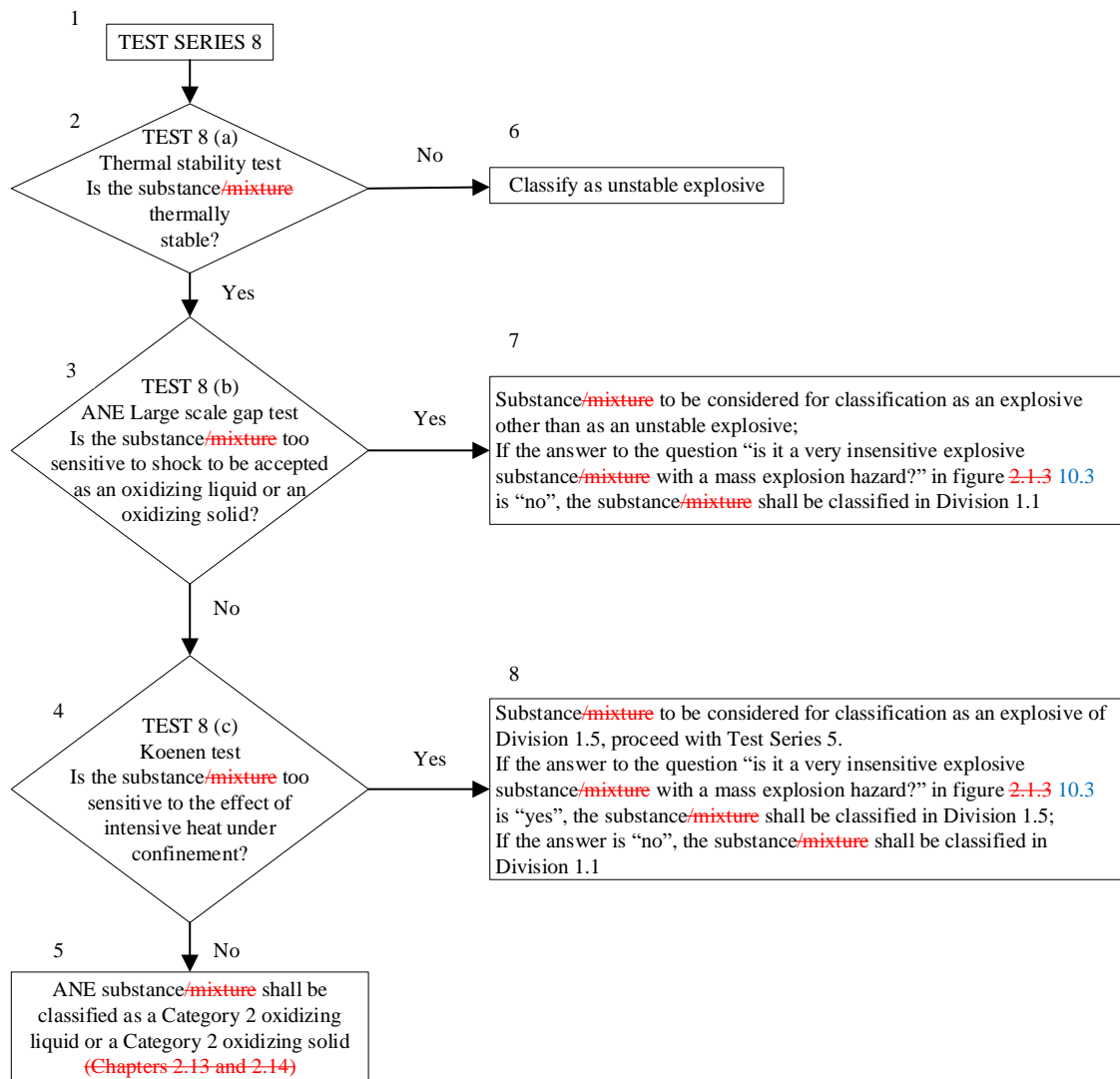
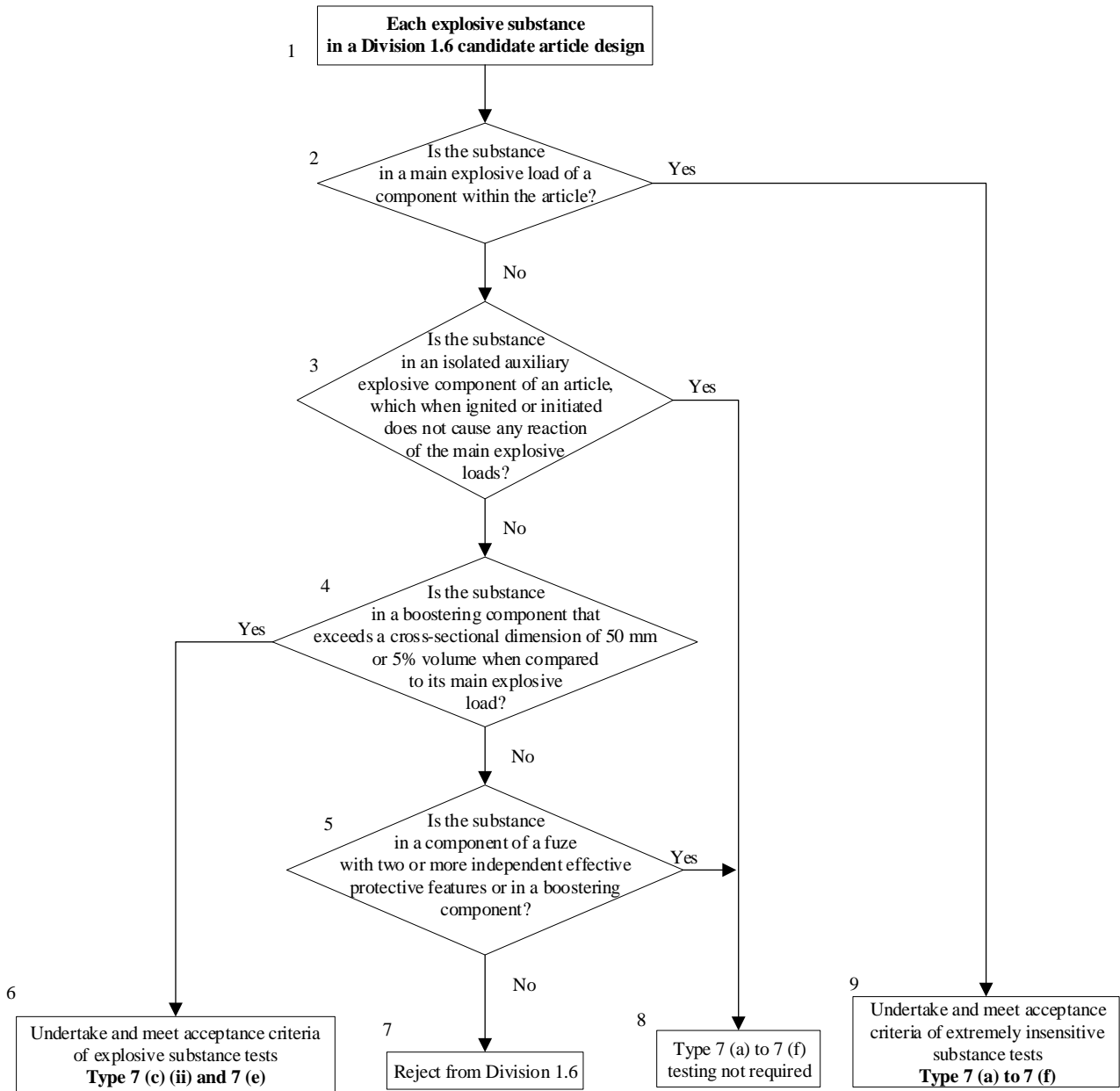


Figure 10.5: PROCEDURE TO DETERMINE REQUIRED SUBSTANCE TESTING FOR DIVISION 1.6



10.4.2.3 The results from four types of series 6 tests, as appropriate, are used to determine which division, amongst Divisions 1.1, 1.2, 1.3 and 1.4, corresponds most closely to the behaviour of a product the explosive if it a load is involved in a fire resulting from internal or external sources or an explosion from internal sources (boxes ~~26, 28, 30, 32, 32a and 33~~ 32, 33, 34, 35, 36 and 37 of Figure 10.3). The results are also necessary to assess whether a product substance or article in the transport configuration can be assigned to compatibility group S of Division 1.4 and whether or not it can ~~should~~ be excluded from the class of explosives ~~Class 1~~ (boxes ~~38 35~~ and ~~39 36~~ of Figure 10.3). The four types of test are:

- Type 6 (a): a test on a single package to determine if there is mass explosion of the contents;
- Type 6 (b): a test on packages of an explosive substance or explosive articles, or non-packaged explosive articles, to determine whether an explosion is propagated from one package to another or from a non-packaged article to another;
- Type 6 (c): a test on packages of an explosive substance or explosive articles, or non-packaged explosive articles, to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning or any other dangerous effect when involved in a fire; and
- Type 6 (d): a test on an unconfined package of explosive articles to which special provision 347 of Chapter 3.3 of the Model Regulations applies, to determine if there are hazardous effects outside the package arising from accidental ignition or initiation of the contents.

10.4.2.4 The question "Is it an extremely insensitive explosive article?" (box ~~23 40~~, Figure 10.3) is answered by series 7 tests and any candidate for Division 1.6 shall ~~should~~ pass one of each of the eleven types of test comprising the series. The protocol for determining the test requirements is given in Figure 10.5. The first six types of test (7 (a) to 7 (f)) are used to establish if a substance is an extremely insensitive substance (EIS). The purpose of these tests is to develop an understanding of the sensitivity of substance(s) contained within the article, which informs and provides confidence in the article tests. The remaining five types of test (7 (g), 7 (h), 7 (j), 7 (k) and 7 (l)) are used to determine if an article predominantly containing an EIS may be assigned to Division 1.6. The eleven test types are:

- Type 7 (a): a shock test to determine the sensitivity to intense mechanical stimulus;
- Type 7 (b): a shock test with a defined booster and confinement to determine the sensitivity to shock;
- Type 7 (c): a test to determine the sensitivity of the explosive substance to deterioration under the effect of an impact;
- Type 7 (d): a test to determine the degree of reaction of the explosive substance to impact or penetration resulting from a given energy source;
- Type 7 (e): a test to determine the reaction of the explosive substance to an external fire when the material is confined;
- Type 7 (f): a test to determine the reaction of the explosive substance in an environment in which the temperature is gradually increased to 365 °C;
- Type 7 (g): a test to determine the reaction to an external fire of an article ~~which is in the condition~~ as presented for ~~classification-transport~~;
- Type 7 (h): a test to determine the reaction of an article in an environment in which the temperature is gradually increased to 365 °C;
- Type 7 (j): a test to determine the reaction of an article to impact or penetration resulting from a given energy source;

- Type 7 (k): a test to determine whether the detonation of an article will initiate a detonation in an adjacent, like, article; and
- Type 7 (l): a test to determine the sensitivity of an article to shock directed at vulnerable components.

10.4.2.5 The question "Is ~~the substance~~ it a candidate for ammonium nitrate emulsion, ~~or~~ suspension or gel, intermediate for blasting explosives (ANE)?" (box 3 ~~2(a)~~, Figure 10.2) is answered by series 8 tests and any candidate should pass each of the three tests comprising the series. The three test types are:

- Type 8 (a): a test to determine the thermal stability;
- Type 8 (b): a shock test to determine sensitivity to intense shock;
- Type 8 (c): a test to determine the effect of heating under confinement;

Test series 8 (d) has been included in this section as one method to evaluate the suitability of ANEs for ~~containment the transport~~ in portable tanks as ~~a-oxidizing~~ substances.

10.4.3 *Application of the test methods*

10.4.3.1 Explanations of certain terms used in the assignment of divisions and compatibility groups are given in the Glossary in Appendix B of the Model Regulations (e.g. mass explosion, pyrotechnic substance, entire load, total contents, explode, explosion of the total contents).

10.4.3.2 Test series 5 should be used to determine whether a substance can be assigned to Division 1.5. Only those substances which pass all three types of test may be assigned to Division 1.5.

10.4.3.3 Test series 6 should be applied to packages of explosive substances and articles in the condition and form in which they are offered for transport. The geometrical arrangement of the products should be realistic in regard to the packing method, and the conditions of transport, and should be such as to produce the most ~~severe disadvantageous~~ test results. Where explosive articles are ~~classified to be carried~~ without packaging, the tests should be applied to the non-packaged articles. All types of packaging containing substances or articles should be subjected to the tests unless:

- (a) The product, including any packaging, can be unambiguously assigned to a division, ~~where appropriate~~ by the competent authority, on the basis of results from other tests or of available information; or
- (b) The product, including any packaging, is assigned to Division 1.1.

10.4.3.4 Test types 6 (a), 6 (b), 6 (c) and 6 (d) are normally performed in alphabetical order. However, it is not always necessary to follow this order or to conduct all four types of test.

- (a) Test type 6 (a) may be waived if explosive articles are ~~classified carried~~ without packaging or when only one article is in the package, (see also ~~section sub-paragraph~~ 10.4.3.4 (d) ~~below~~);
- (b) Test type 6 (b) may be waived if, in each type of 6 (a) test, (see also ~~section sub-paragraph~~ 10.4.3.4 (d) ~~below~~):
 - (i) The exterior of the package is undamaged by internal ~~initiation detonation and/or ignition~~; or
 - (ii) The contents of the package fail to explode, or explode so feebly as would exclude propagation of the explosive effect from one package to another in test type 6 (b).

- (c) Test type 6 (c) may be waived if, in a type 6 (b) test, there is a practically instantaneous explosion of virtually the total contents of the stack. In such cases the product is assigned to Division 1.1.
- (d) Test type 6 (d) is a test used to determine whether a 1.4S classification is appropriate and is only used if special provision 347 of Chapter 3.3 of the Model Regulations applies. When testing articles to which special provision 347 applies, test type 6 (d) may be performed first. If the results of test type 6 (d) indicate that a 1.4S classification is appropriate, then test types 6 (a) and 6 (b) may be waived.

10.4.3.5 If a substance gives a "-" result (no propagation of detonation) in the Series 1 type (a) test, the 6 (a) test with a detonator may be waived. If a substance gives a "-" result (no or slow deflagration) in a Series 2 type (c) test, the 6 (a) test with an igniter may be waived.

10.4.3.6 Tests types 7 (a) to 7 (f) ~~are should be~~ used to establish that ~~an the~~ explosive is an extremely insensitive ~~detonating~~ substance and then test types 7 (g), 7 (h), 7 (j), 7 (k) and 7 (l) ~~are~~ used to establish that the articles ~~predominantly~~ containing EIS(s) may be assigned to Division 1.6.

10.4.3.7 Tests of types 7 (g), 7 (h), 7 (j), 7 (k) and 7(l) ~~are should be~~ performed to determine if an article with EIS main explosive load(s) and appropriately insensitive boosting components may be assigned to Division 1.6. These tests are applied to articles in the condition and form in which they are offered for ~~classification transport~~, except that non-explosive components may be omitted or simulated if the ~~competent authority classifier~~ is satisfied that this does not invalidate the results of the tests. The procedure detailing testing requirements is given in Figure 10.5 and some points of explanation are given below.

- (a) Complex articles may contain multiple substances and ~~test types 7(a) to (f) shall this procedure should~~ be completed for all ~~main explosive load and boosting component substances, as appropriate~~, within the article to be classified ~~in Division 1.6~~.
- (b) The question "Is the substance in a main explosive load of a component within the article?" (Box 2 of Figure 10.5) is answered by examining the design of the article. Main explosive load substances are those loaded into components within the article that are not fuze, boosting, or isolated auxiliary explosive components. All substances in main explosive loads must "Undertake and meet acceptance criteria of extremely insensitive substance tests, Type 7 (a) to 7 (f)" (Box 39 of Figure 10.5). If a '+' result is obtained for any main explosive load substance to any Type 7 (a) to 7 (f) test, the substance is not an EIS and the answer to the question in Box 24 21 of Figure 10.3 is "No". The article is not a candidate for Division 1.6.
- (c) Answering the question "Is the substance in an isolated auxiliary explosive component of the article, which when ignited or initiated does not cause any reaction of the main explosive loads?" (Box 4 3 of Figure 10.5) requires knowledge of the design of the article plus the explosive effects that occur when such components are initiated or ignited, either in their design mode or accidentally. Typically these will be small explosive actuators or pyromechanical devices that produce movement, cutting or opening functions. If the answer is 'yes' to this question, Type 7 (a) to 7 (f) testing is not required for substances in isolated auxiliary explosive components and the article remains a candidate for Division 1.6.
- (d) The question "Is the substance in a boosting component that exceeds a cross-sectional dimension of 50 mm or 5% volume when compared to its main explosive load?" (Box 4 6 of Figure 10.5) is answered by examining the design of the article. All substances in such larger boosting components, including those contained in explosive components of dual-protected fuzes in an article, must "Undertake and meet acceptance criteria of explosive substance tests, Type 7 (c) (ii) and 7 (e)" (box 7 6 of Figure 10.5). If a '+' result is obtained for any such larger boosting component substance to either Type 7 (c) (ii) and 7 (e) tests, the

answer to the question in Box 24 21 of Figure 10.3 is "No". The article is not a candidate for Division 1.6.

- (e) The question "Is the substance in a component of a fuze with two or more independent effective protective features or in a boosting component" (Box 5 8 of Figure 10.5) is answered by an understanding of the design and development of the article. If the answer is 'no', the article is not considered to have suitable intrinsic safety characteristics and the answer to the question in Box 24 21 of Figure 10.3 is 'No' the article is not a candidate for Division 1.6.

NOTE: Knowledge of the design and explosive effects can be obtained by modelling or indicative tests etc.

10.4.3.8 Test types 8 (a) to 8 (c) should be used to establish whether an ammonium nitrate emulsion or suspension or gel, intermediate for blasting explosives (ANE) may be accepted as an oxidizing solid or liquid assigned to Division 5.1. Substances failing any of the tests may be considered as a candidate for the class of explosives Class 1 in accordance with Figure 10.4.

~~10.4.3.9 If articles contain expensive, inert, control components, these may be replaced by inert components having a similar mass and volume.~~

10.5 Examples of test reports

10.5.1 Examples of test reports, with an illustration of the use of the flow charts on the application of the class of explosives Class 1 acceptance and assignment procedures to hexanitrostilbene (UN No.0392) and musk xylene (UN No.2956), are given in figures 10.6 (a) to (d) and 10.97 (a) to (d).

10.5.2 An example proforma for a test report on articles is given in Figure 10.108.

Figure 10.6 (a): RESULTS FROM THE APPLICATION OF THE PROVISIONAL ACCEPTANCE PROCEDURE IN THE CLASS OF EXPLOSIVES (FIGURE 10.2) TO HEXANITROSTILBENE

1.	Name of substance:	Hexanitrostilbene
2.	General data	
2.1	Composition:	hexanitrostilbene
2.2	Molecular formula:	C ₁₄ H ₆ N ₆ O ₁₂
2.3	Physical form:	powder
2.4	Colour:	yellow orange
2.5	Apparent density:	1700 kg /m ³
2.6	Particle size:	0.1 – 0.3 mm
3.	Box 2:	Is the substance manufactured with the view to producing a practical explosive or pyrotechnic effect?
3.1	Answer:	Yes
3.2	Exit	Go to Box 10
4.	Box 10:	Substance to be considered in this class
5.	Box 11:	Test Series 3
5.1	Thermal stability:	75 °C/48 hour test (test 3 (c))
5.2	Sample conditions:	100 g of substance at 75 °C
5.3	Observations:	No ignition, explosion, self-heating or visible decomposition
5.4	Result:	"-", thermally stable
5.5	Impact sensitivity:	BAM fallhammer test (test 3 (a) (ii))
5.6	Sample conditions:	as received
5.7	Observations:	Limiting impact energy 5 J
5.8	Result:	"-", not unstable in the form it was tested
5.9	Friction sensitivity:	BAM friction test (test 3 (b) (i))
5.10	Sample conditions:	as received
5.11	Observations:	Limiting load > 240 N
5.12	Result:	"-", not unstable in the form it was tested
5.13	Ease of deflagration to detonation transition	Small scale burning test (test 3 (d))
5.14	Sample conditions:	Ambient temperature
5.15	Observations:	Ignites and burns
5.16	Result:	"-", not unstable in the form it was tested
5.17	Exit:	Go to box 12
6.	Box 12:	Is it thermally stable?
6.1	Answer from test 3(c):	Yes
6.2	Exit:	Go to box 13
7.	Box 13:	Is it unstable in the form it was tested?
7.1	Answer from Test Series 3:	No
7.2	Exit:	Go to box 19
8.	Conclusion:	PROVISIONALLY ACCEPT INTO THIS CLASS
8.1	Exit:	Apply procedure for assignment to a division of the class of explosives

Figure 10.6 (b): FLOW CHART FOR THE PROVISIONAL ACCEPTANCE OF HEXANITROSTILBENE IN THE CLASS OF EXPLOSIVES

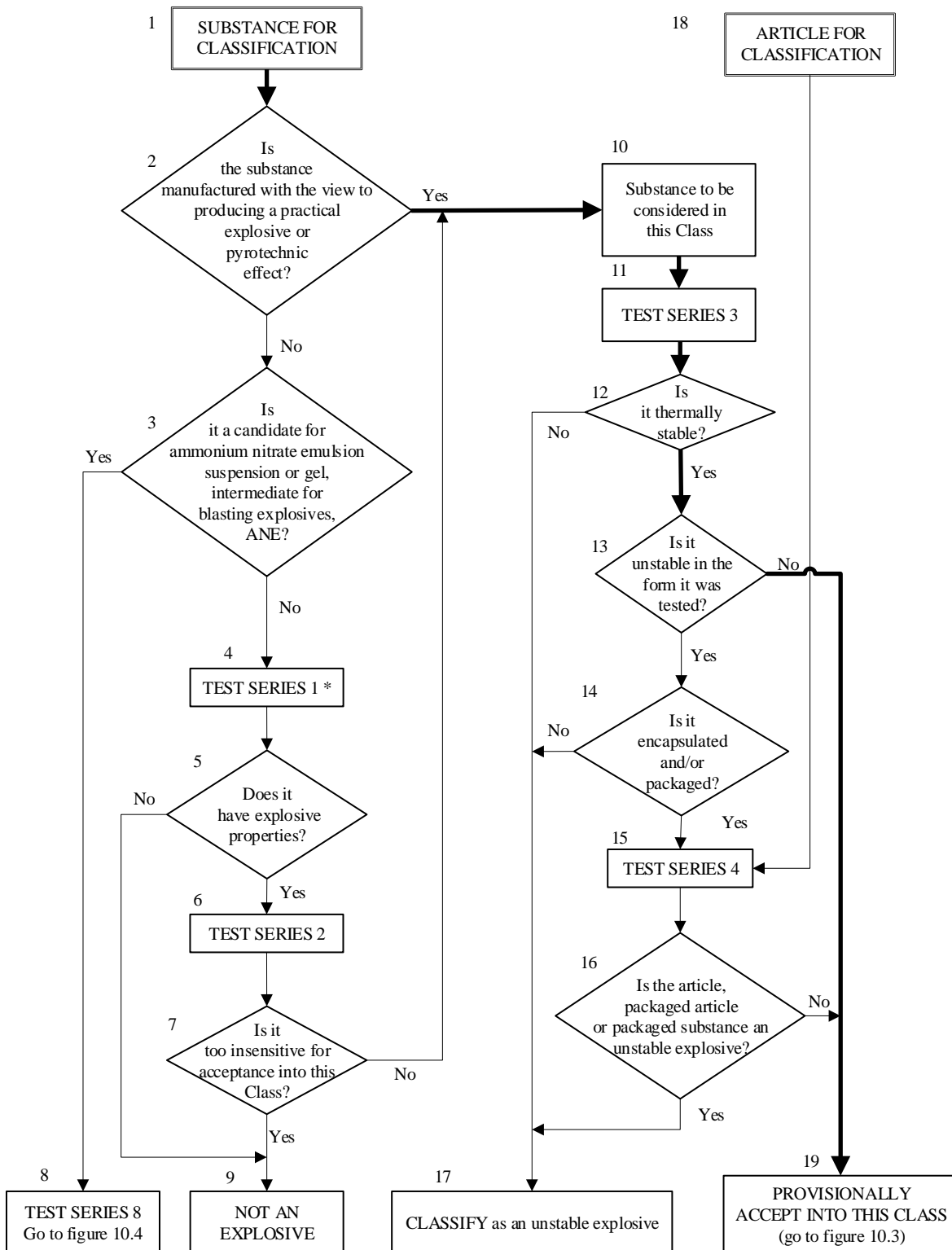


Figure 10.6 (c): RESULTS FROM APPLICATION OF THE PROCEDURE FOR ASSIGNMENT TO A DIVISION OF THE CLASS OF EXPLOSIVES (FIGURE 10.3) TO HEXANITROSTILBENE

- | | |
|--|--|
| 1. Box 26: | Is the substance a candidate for Division 1.5? |
| 1.1 Answer: | No |
| 1.2 Result: | Package the substance (box 30) |
| 1.3 Exit: | Go to box 31 |
| 2. Box 31: | Test Series 6 |
| 2.1 Effect of initiation in the package: | Test 6 (a) with detonator |
| 2.2 Sample conditions: | Ambient temperature, 50 kg fibreboard drum |
| 2.3 Observations: | Detonation, crater |
| 2.4 Result: | Mass explosion |
| 2.5 Effect of ignition between packages: | Test 6 (b) with detonator |
| 2.6 Sample conditions: | Ambient temperature, 3 fibreboard drums |
| 2.7 Observations: | Detonation, crater |
| 2.8 Result: | Mass explosion |
| 2.9 Effect of fire engulfment: | Test 6 (c) not required |
| 3. Box 32: | Is the result a mass explosion? |
| 3.1 Answer from Test Series 6 | Yes |
| 3.2 Exit | Go to box 44 |
| 4. Conclusion | Assign to Division 1.1 |

Figure 10.6 (d): FLOW CHART FOR ASSIGNMENT TO A DIVISION OF THE CLASS OF EXPLOSIVES OF HEXANITROS TILBENE

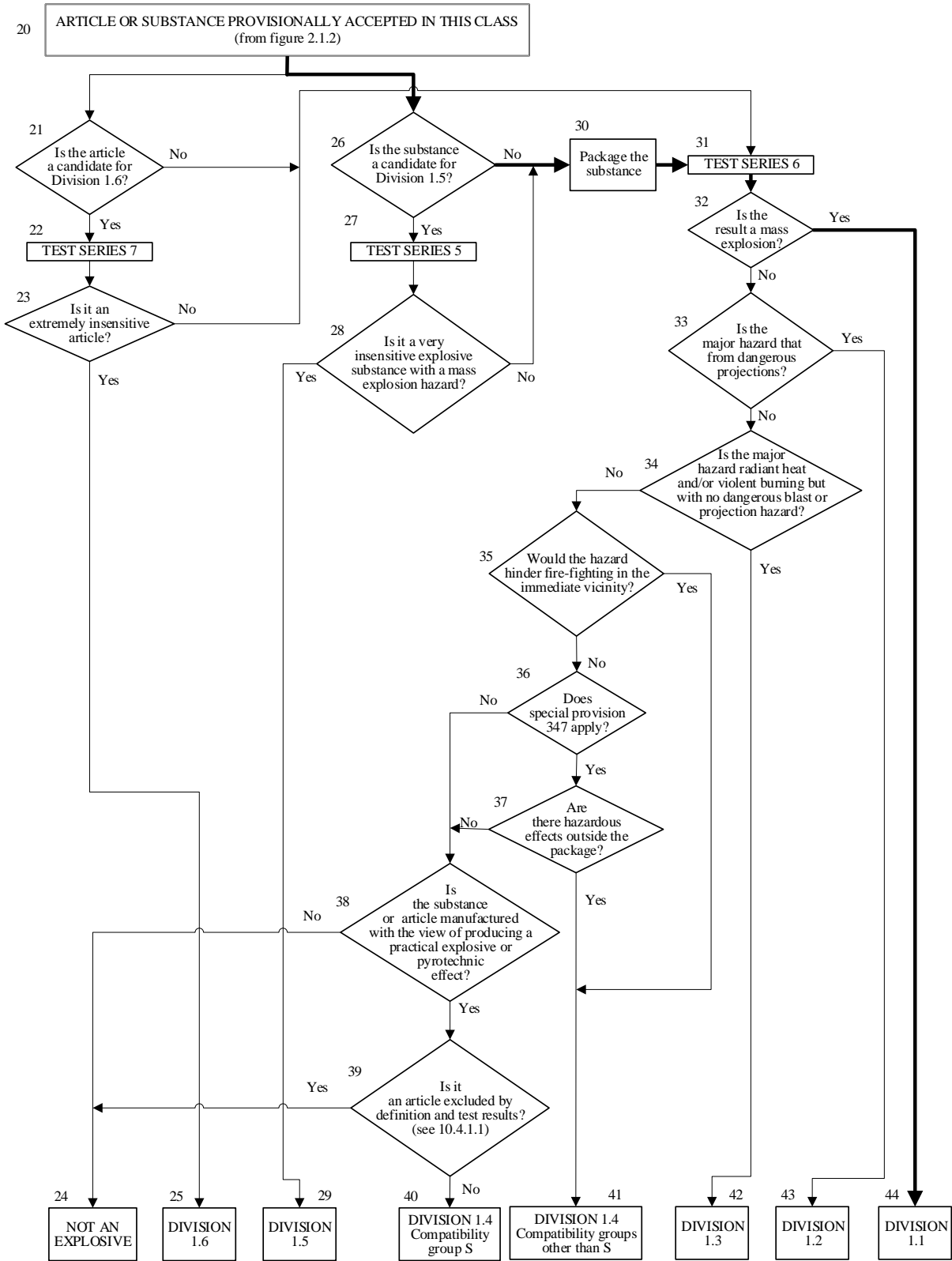


Figure 10.7(a): RESULTS FROM THE APPLICATION OF THE PROVISIONAL ~~THE CLASS 1~~ ACCEPTANCE PROCEDURE IN THE CLASS OF EXPLOSIVES (FIGURE 10.2) TO MUSK XYLENE

1.	Name of substance	:	5-tert-BUTYL-2,4,6-TRINITRO-m-XYLENE (MUSK XYLENE)
2.	General data		
2.1	Composition	:	99% tert-butyl-2,4,6-trinitro-m-xylene
2.2	Molecular formula	:	C ₁₂ H ₁₅ N ₃ O ₆
2.3	Physical form	:	Fine crystalline powder
2.4	Colour	:	Pale yellow
2.5	Apparent density	:	840 kg /m ³
2.6	Particle size	:	< 1.7 mm
3.	Box 2	:	Is the substance manufactured with the view to producing a practical explosive or pyrotechnic effect?
3.1	Answer	:	No
3.2	Exit	:	Go to Box 2a3
4.	Box 2a3	:	Is it a candidate for ammonium nitrate emulsion, suspension or gel, intermediate for blasting explosives, ANE?
4.1	Answer	:	No
4.2	Exit	:	Go to Box 4
54.	Box 34	:	Test Series 1
54.1	Propagation of detonation	:	UN gap test (test 1(a))
54.2	Sample conditions	:	Ambient temperature
54.3	Observations	:	Fragmentation length 40 cm
54.4	Result	:	"+", propagation of detonation
54.5	Effect of heating under confinement	:	Koenen test (test 1(b))
54.6	Sample conditions	:	Mass 22.6 g
54.7	Observations	:	Limiting diameter 5.0 mm Fragmentation type "F" (time to reaction 52 s, duration of reaction 27 s)
54.8	Result	:	"+", shows some explosive effects on heating under confinement
54.9	Effect of ignition under confinement	:	Time/pressure test (test 1 (c) (i))
54.10	Sample conditions	:	Ambient temperature
54.11	Observations	:	No ignition
54.12	Result	:	"-", no effect on ignition under confinement
54.13	Exit	:	Go to Box 45
65.	Box 45	:	Is it an Does it have explosive substance properties?
65.1	Answer from Test Series 1	:	Yes
65.2	Exit	:	Go to box 56
76.	Box 56	:	Test Series 2

76.1	Sensitivity to shock	:	UN gap test (test 2(a))
76.2	Sample conditions	:	Ambient temperature
76.3	Observations	:	No propagation
76.4	Result	:	"-", not sensitive to shock
76.5	Effect of heating under confinement	:	Koenen test (test 2(b))
76.6	Sample conditions	:	Mass 22.6 g
76.7	Observations	:	Limiting diameter 5.0 mm Fragmentation type "F" (time to reaction 52 s, duration of reaction 27 s)
76.8	Result	:	"+", violent effect on heating under confinement
76.9	Effect of ignition under confinement	:	Time/pressure test (test 2 (c) (i))
76.10	Sample conditions	:	Ambient temperature
76.11	Observations	:	No ignition
76.12	Result	:	"-", no effect on ignition under confinement
76.13	Exit	:	Go to Box 67
87.	Box 67	:	Is the substance it too insensitive for acceptance into this Class 4 ?
87.1	Answer from Test Series 2:	No	
87.2	Conclusion	:	Substance to be considered for in this Class 4 (box 810)
87.3	Exit	:	Go to Box 911
98.	Box 911	:	Test Series 3
98.1	Thermal stability	:	75 °C/48 hour test (test 3 (c))
98.2	Sample conditions	:	100 g of substance at 75 °C
98.3	Observations	:	No ignition, explosion, self-heating or visible decomposition
98.4	Result	:	"-", thermally stable
98.5	Impact sensitivity	:	BAM fallhammer test (test 3 (a) (ii))
98.6	Sample conditions	:	as received
98.7	Observations	:	Limiting impact energy 25 J
98.8	Result	:	"-", not too dangerous to transport unstable in <u>the form it was tested</u>
98.9	Friction sensitivity	:	BAM friction test (test 3 (b) (i))
98.10	Sample conditions	:	as received
98.11	Observations	:	Limiting load > 360 N
98.12	Result	:	"-", not too dangerous to transport unstable in <u>the form it was tested</u>
98.13	Ease of deflagration to detonation transition	:	Small scale burning test (test 3 (d))
98.14	Sample conditions	:	Ambient temperature
98.15	Observations	:	Ignites and burns slowly
98.16	Result	:	"-", not too dangerous to transport unstable in <u>the form it was tested</u>
98.17	Exit	:	Go to box 1012
109.	Box 1012	:	Is it the substance thermally stable?
109.1	Answer from test 3(c)	:	Yes
109.2	Exit	:	Go to box 1113

- 1140. Box 1113** : Is ~~the substance too dangerous for transport~~ it unstable in the form it was tested?
- 1140.1 Answer from Test Series 3: No
- 1140.2 Exit : Go to box 1918
- 1211. Conclusion** : PROVISIONALLY ACCEPT INTO THIS CLASS-1
- 1211.1 Exit : Apply ~~the Class 1 assignment~~ procedure for assignment to a division of the class of explosives

Figure 10.7 (b): PROCEDURE—FLOW CHART FOR THE PROVISIONAL ACCEPTANCE OF MUSK XYLENE IN THE CLASS OF EXPLOSIVES¹

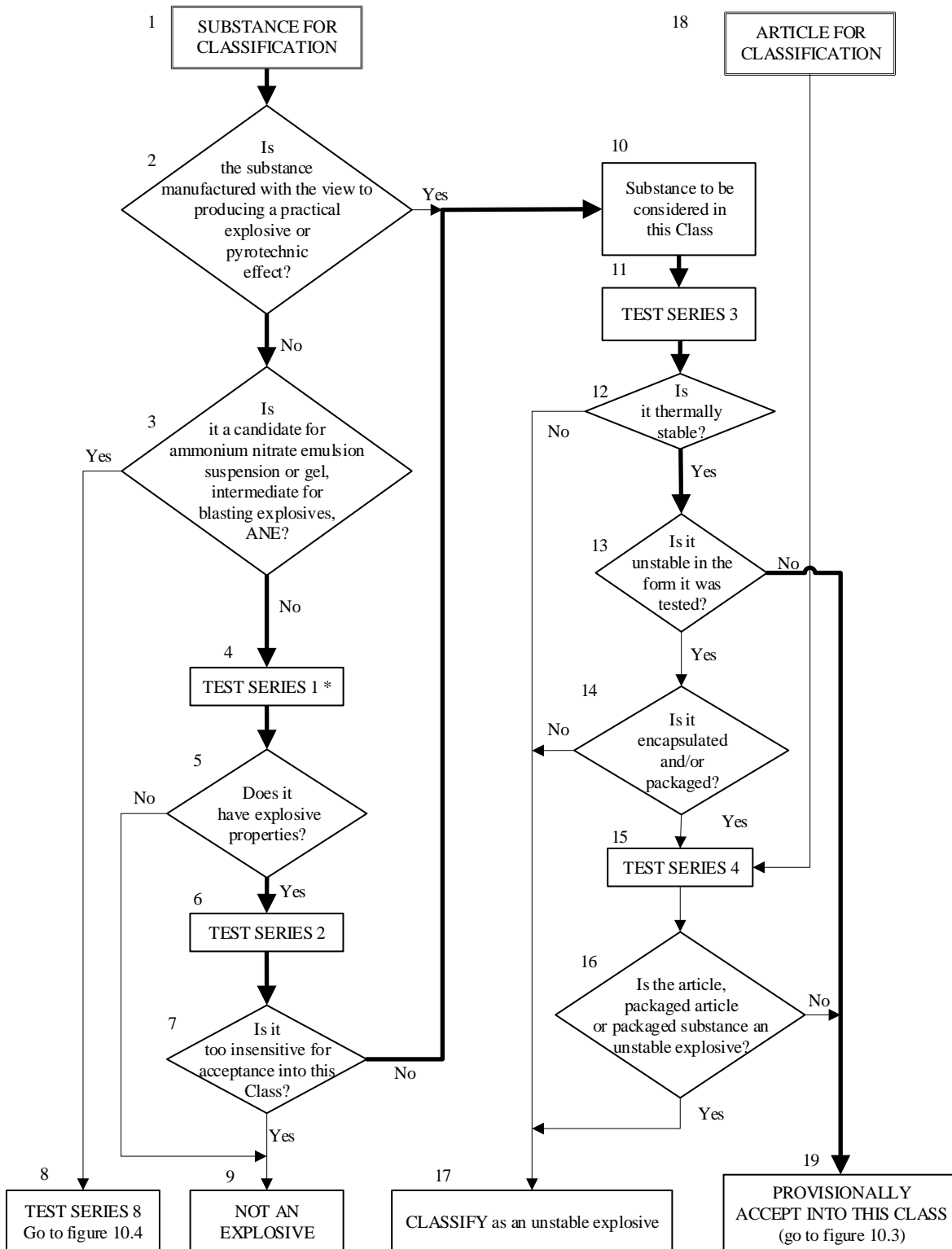


Figure 10.78(c): RESULTS FROM APPLICATION OF THE ~~CLASS 1 ASSIGNMENT~~ PROCEDURE FOR ASSIGNMENT TO A DIVISION OF THE CLASS OF EXPLOSIVES (FIGURE 10.3) OF MUSK XYLENE

1.	Box 1926	:	Is the substance a candidate for Division 1.5?
1.1	Answer	:	No
1.2	Result	:	Package the substance (box 2330)
1.3	Exit	:	Go to box 2531
2.	Box 2531	:	Test Series 6
2.1	Effect of initiation in the package	:	Test 6(a) with detonator
2.2	Sample conditions	:	Ambient temperature, 50 kg fibreboard drum
2.3	Observations	:	Only localised decomposition around detonator
2.4	Result	:	No significant reaction
2.5	Effect of ignition in the package	:	Test 6 (a) with igniter
2.6	Sample conditions	:	Ambient temperature, 50 kg fibreboard drum
2.7	Observations	:	Only localised decomposition around igniter
2.8	Result	:	No significant reaction
2.9	Effect of propagation	:	Type 6 (b) test not required as no effect outside package between packages in 6(a) test
2.10	Effect of fire engulfment	:	Test 6(c)
2.11	Sample conditions	:	3 × 50 kg fibreboard drums mounted on steel frame above wooden crib fire
2.12	Observations	:	Only slow burning with black smoke occurred
2.13	Result	:	No effects which would hinder fire fighting
2.14	Exit	:	Go to box 2632
3.	Box 2632	:	Is the result a mass explosion?
3.1	Answer from Test Series 6:	No	
3.2	Exit	:	Go to box 2833
4.	Box 2833	:	Is the major hazard that from dangerous projections?
4.1	Answer from Test Series 6	:	No
4.2	Exit	:	Go to box 3034
5.	Box 3034	:	Is the major hazard radiant heat and/or violent burning but with no dangerous blast or projection hazard?
5.1	Answer from Test Series 6:	No	
5.2	Exit	:	Go to box 3235
6.	Box 3235	:	Is there nevertheless a small hazard in the event of ignition or initiation? Would the hazard hinder fire-fighting in the immediate vicinity?
6.1	Answer from Test Series 6	:	No
6.2	Exit	:	Go to box 32a36
7.	Box 32a36	:	Does special provision 347 apply?
7.1.	Answer	:	No

- 7.2. Exit : Go to box ~~35~~38
8. **Box ~~35~~38** : Is the substance or article manufactured with the view ~~to~~of producing a practical explosive or pyrotechnic effect?
- 8.1 Answer : No
- 8.2 Exit : Go to box ~~38~~24
9. **Conclusion** : NOT ~~CLASS 1~~AN EXPLOSIVE
- 9.1 Exit : Consider for another class/division

Figure 10.79(d): PROCEDURE FOR EXEMPTION OF MUSK XYLENE FROM THE CLASS OF EXPLOSIVES

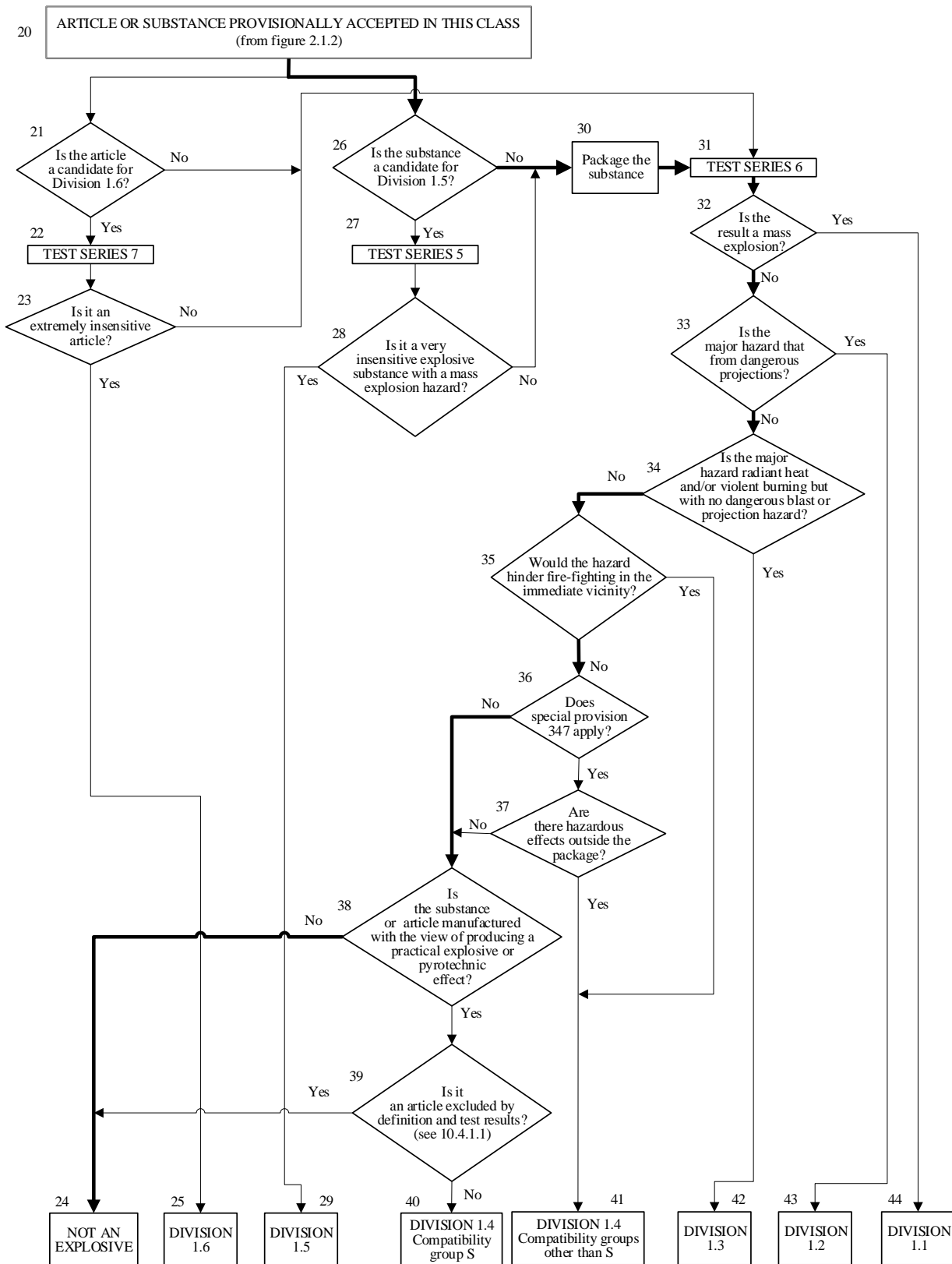


Figure 10.810: EXAMPLE OF A PROFORMA FOR A TEST REPORT FOR ARTICLES

Test method		Date of report		Data reference	
Product name		Lot number		Date of manufacture	

CONSTRUCTION AND CONTENTS (attach drawings)

PACKAGING (if any)

PRETREATMENT OR CONDITIONING (if any)

TEST CONFIGURATION (including any variations or deviations from procedures described in the Manual)

TEST CONDITIONS

Ambient temperature: °C Relative humidity: %

OBSERVATIONS

TEST RESULT

CONCLUSION
