Model code of safe practice

Part 15

Area classification for installations handling flammable fluids

4th edition

energy institute

MODEL CODE OF SAFE PRACTICE PART 15
AREA CLASSIFICATION FOR INSTALLATIONS HANDLING FLAMMABLE FLUIDS

4th edition

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FOREWORD

EI *Model code of safe practice – Part 15: Area classification code for installations handling flammable* fluids (EI15, formerly referred to as IP15) is a well-established Model Code for area classification in the petroleum industry. It provides a demonstrable methodology for determining hazard radii, applicable to installations handling flammable fluids. Identifying and designating areas in which there is a risk of a flammable (explosive) atmosphere occurring is a legal duty under the Dangerous Substances and Explosives Atmospheres Regulations 2002, (DSEAR) [which implement ATEX Directive 99/92/EC setting minimum requirements for improving the safety & health of workers potentially at risk from explosive atmospheres], and the Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations, 1995, (PFEER).

The fourth edition of this Model Code provides clarification on issues that have been raised by users of the third edition since its publication in 2005 and also incorporates key findings from a number of research studies commissioned by the EI. In addition, further editorial changes have been made.

The Model Code applies dispersion modelling to the calculation of hazard radii, taking into account variables such as pressure of release and the effect of mist or spray formation. The current methodology takes account of both the composition of the material released and its release conditions including the release pressure, together with sensitivity to various operating parameters.

The Model Code also provides a risk-based approach for specifying hazardous areas from secondary grade sources of release, allowing further flexibility in specifying hazard radii. Whilst the Model Code includes the basis of the risk-based approach, the full methodology is provided in the publication EI *A risk-based approach to hazardous area classification,* 2nd edition, 2015.

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Suggested revisions are invited and should be submitted to the Technical Department, Energy Institute, 61 New Cavendish Street, LONDON W1G 7AR.

KEY TECHNICAL CHANGES

This section sets out in a generalised form, a summary of the key technical changes between the third and fourth editions of EI15.

The key technical changes comprise:

1. Emphasis being placed on the use of the point source approach for area classification and relocation of direct examples to Annex D.
2. Amendments to the point source approach – amended hazard radii for secondary grade releases from pumps, compressors, flanges and valves (based upon revised equivalent hole sizes); along with amended hazard radii from pool spills.
3. Annex C, calculation of hazard radii, has been reordered and restructured to aid user understanding.
4. Examples on how to assess whether ventilation is 'adequate' are provided.
5. Expansion of Annex F on ventilation and releases within enclosed areas to include pertinent findings in HSE Research Report: *Technical input on ventilation effectiveness for area classification guidance EI15.*
6. Amendments to guidance on ventilation of hazardous areas. Amended definition of 'adequate ventilation' and other key findings from HSE Research Report *Technical Input on ventilation effectiveness for area classification guidance EI15*. Based on this work some sections have been restructured and sections which are no longer technically valid have been deleted.
7. Incorporation of conclusions in EI *Research Report: Dispersion modelling and calculations in support of EI Model code of safe practice – Part 15: Area classification code for installations handling flammable fluids*, including a sensitivity analysis to various parameters.
8. Incorporation of further background technical information on hazard radii from pool spills.
9. Incorporation of hazard radii and background information for LNG releases.
10. Revised 'equivalent hole sizes' for frequency bands (LEVEL I – III), based on analysis of the HSE Hydrocarbon Release Database (HCR).
11. Amplification of the discussion of the limits of applicability of the Model Code.
12. Amplification of the discussion of grades of release, particularly with reference to detection times.
13. Revision of the guidance on the formation of flammable mists, noting further research into this subject is ongoing.
14. Guidance and recommendations on equipment design, information on protection concepts and fired process heaters and guidance on equipment selection and non-electrical sources of ignition have been removed and incorporated into EI *Model code of safe practice – Part 1: The selection, installation, inspection, and maintenance of electrical and non electrical apparatus in hazardous areas.*

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It also wishes to recognise the contribution made by those individuals, companies and organisations that provided comments since publication of the 3rd edition which have resulted in this revised edition.

OVERVIEW

GENERAL: This Model Code presents approaches to be used in area classification: the point source approach, where release rates are dependent on process conditions, and the direct example approach, which is limited to common facilities. The risk-based approach is included within the point source approach for a risk-based methodology for determining unknown release hole sizes for secondary grade releases, where actual hole size is not available.

CHAPTER 1: Establishes the scope of the Model Code and defines key terms. It indicates a means of defining flammable fluids for area classification purposes by their flash points and, where extremes of volatility, temperature and pressure occur, by fluid category. Figure 1.1 provides a guide to applying the Model Code and selecting the appropriate approach to be used.

CHAPTER 2: Identifies the information required to classify a hazardous area and explains the technique of area classification by use of either the point source or direct example approach. It also describes the area classification drawing.

CHAPTER 3: Describes the point source approach and provides the basis for the hazard radii specified throughout the Model Code. These are based on the results of dispersion modelling published in EI *Research report: Dispersion modelling and calculations in support of EI Model code of safe practice – Part 15: Area classification code for installations handling flammable fluids,* which allows for variations in release rates and operational pressures. A risk-based approach is also provided for determining the extent of Zone 2 hazardous areas where release hole sizes are not specified.

CHAPTER 4: Provides guidance on the effect of ventilation on hazard radii and zone classification in non-open areas. The different degrees of ventilation are described and Figure 4.1 provides a procedure for assessing the type and degree of ventilation for given situations. Open areas, sheltered areas and enclosed areas are defined and the application of area classification to each situation is described. Methods of artificial ventilation and the effect of loss of ventilation on the area classification are discussed.

ANNEX A: Provides background information on EI classes of petroleum, and their relationship to the fluid categories used in this Model Code. Implications of flammable fluids being released as a mist or spray are discussed.

ANNEX B: Summarises work done on assessing the area classification of hydrogen and hydrogen-containing streams.

ANNEX C: Presents the background to the calculation of hazard radii for release rates used in Chapter 3, based on dispersion modelling in EI *Research report: Dispersion modelling and calculations in support of EI Model code of safe practice – Part 15: Area classification code for installations handling flammable fluids*. Also, for use with the risk-based approach, Annex C describes the procedure for determining appropriate release frequency for release rates, to be used in conjunction with Chapter 3 and describes the background to the risk-based approach and how risk tolerability criteria are related to release frequencies and corresponding release hole sizes.

ANNEX D: Provides direct examples, with diagrams, which can be used to classify common facilities; distances are valid for the conditions given. However, the Annex also refers to the point source approach in Chapter 3 for variable releases (e.g. releases from tank vents).

ANNEX E: Presents a discussion on small scale operations including research and development installations (e.g. pilot plants, laboratories, etc.) where special features will need to be considered in assessing the fire and explosion risk, and the approach to area classification.

ANNEX F: Provides background information and examples on the assessment of ventilation of enclosed areas. Releases within enclosed areas, such as buildings, and associated external hazardous areas are also discussed.

ANNEX G: Glossary of terms used in this Model Code.

ANNEX H: List of references cited in this Model Code.

1 INTRODUCTION

1.1 SCOPE

This Model Code gives guidance on the classification of areas around equipment handling or storing flammable fluids, and provides a basis for both the correct selection of fixed electrical equipment and the location of other sources of ignition in those areas. An 'area' in this context is always taken to be three-dimensional. Area classification zoning restrictions should be considered when introducing and using any temporary electrical equipment or mobile equipment capable of generating a source of ignition, to a facility.

It is intended that the guidance given in this Model Code is applicable internationally to installations in processing, distribution, production and retail sectors. The application of this Model Code is limited to flammable fluids similar in physical characteristics to those occurring in the petroleum, petrochemical and allied industries. It does not cover ignitable dusts or the assessment of health risks due to the handling of flammable fluids.

It does not comprehensively address the releases of flammable refrigerated or cryogenic liquids, for which the dispersion characteristics are markedly different from those of fluids at higher temperatures. The general approach presented in the Model Code may be applied to such releases if specific dispersion modelling, using the appropriate dispersion characteristics, is performed. For this purpose, a limited amount of information and guidance on the hazardous areas generated by those fluids is given. It can, however, be used for situations where vented boil-off vapour is released at around ambient temperatures. If it is desired to consider area classification for the liquids, it will be necessary to carry out specific calculations using suitable dispersion models, e.g. those applied in the calculation of radii provided in Annex C Part 1, published in EI *Research report: Dispersion modelling and calculations in support of EI Model code of safe practice – Part 15: Area classification code for installations handling flammable fluids*.

General guidance as to the main principles, definitions and explanations of terms relating to area classification has also been set out internationally by the International Electrotechnical Commission (IEC) and in Europe by the European Committee for Standardization (CEN), followed nationally by bodies such as, in the United Kingdom, the British Standards Institution (BSI). References to standards and guidance issued by these bodies are provided throughout this Model Code.

1.2 LIMITS OF APPLICABILITY

1.2.1 General

The area classification techniques described in this Model Code assume that the facilities to which they are applied are designed, constructed, maintained and operated in accordance with industry good practice so as to reduce the frequency of releases. The guidance contained in a number of EI publications (cited in Annex H) covering good operational and maintenance practice should also be followed.

Area classification should not be used as a prime tool in determining layout. However, aspects of area classification may be considered in determining separation distances. Guidance as to

the recommended spacings between equipment and public boundaries and to other facilities, including sources of ignition, can be found in other industry guidance, Codes of Practice, etc.

In the UK, there are many criteria used for classifying the severity of release e.g. those used in RIDDOR and the HSE Hydrocarbon Release System (HCR). Generally, these regimes classify the severity of a release based on the quantity and duration of a release and are not related to the failure mode of equipment. This Model Code seeks to evaluate equipment failure cases, on which area classification is based.

The aim of area classification is to avoid ignition of those releases that may occur from time to time in the normal operation of facilities handling flammable fluids. The approach is to reduce the probability of coincidence of a flammable atmosphere and an electrical or other source of ignition.

It is not the aim of area classification to prevent the ignition of major accidental releases of flammable materials that could extend to large distances from the release source. These larger accidental releases, which may result from major or catastrophic failure of process or storage equipment, should be dealt with by risk assessment and other procedures or processes including the requirements of relevant legislation.

1.2.2 Extent of hazardous area

The design intent should always be to minimise the extent of the hazard radii. It is not good practice to classify hazardous zones that would reach uncontrolled sources of ignition, such as site roads, occupied buildings and off-site populations. For typical sites these distances can be between 15 m and 30 m.

In the majority of cases, it is expected that the release rates will result in hazard radii significantly less than 30 m, although releases resulting in potential hazard radii greater than 30 m which occur due to design intent, e.g. discharges from a relief valve, vent or high pressure source, should be included in the area classification review. Arrangements should be made if practical to route the discharge to a flare or to discharge at an appropriate location subject to a risk assessment.

If a hazard radius calculated using the point source method is greater than 30 m, then the size of the release is generally larger than that considered for area classification purposes and measures should be taken where practical to eliminate the source or reduce the size of the release.

1.2.3 Small scale operations

As guidance, Table 1.1 details capacity thresholds above which area classification is typically required. However, it would be incorrect to assume that operations involving smaller quantities than these thresholds do not require area classification. Such operations should be separately assessed to determine the size of release that may occur during normal operation (continuous/primary grade release), or foreseeable equipment failure or operator error (secondary grade release) and the risk of harm to an individual should this ignite. Where there is risk of injury, appropriate control and mitigation measures should be taken to protect the health and safety of the individual. Such precautionary measures can include area classification, but this may not always be necessary. For example, in locations handling only small quantities of flammable fluids, such as a laboratory, the control measures taken to minimise releases and limit vapour concentrations to provide a safe atmosphere for the occupants to breathe may remove the

need to designate any area classification. Further guidance may be found in the HSE document *Hazardous area classification and laboratory operations*, available at the UK Health and Safety Executive website.

Further information on the application of area classification to small-scale operations is given in Annex E.

Table 1.1: Capacity thresholds above which area classification is required

	Gas: volume corrected to 1 bar(a) pressure	**Liquefied flammable gas**	**Flammable liquid at a temperature above its flash point**
Inside	50 litres	5 litres	25 litres
Outdoors	1 000 litres	100 litres	200 litres

Whilst these figures are only guides, for inventories below these values, it is up to the user to determine the extent of hazards and necessary safe distances. These figures rely on the use of good practice. It is up to the user to determine the extent of hazard for the materials being stored and handled on the premises.

1.3 APPLICATION OF THIS MODEL CODE

The application of this Model Code and the relevance of each chapter are shown in Figure 1.1 which summarises the area classification procedure.

1.3.1 Other facilities

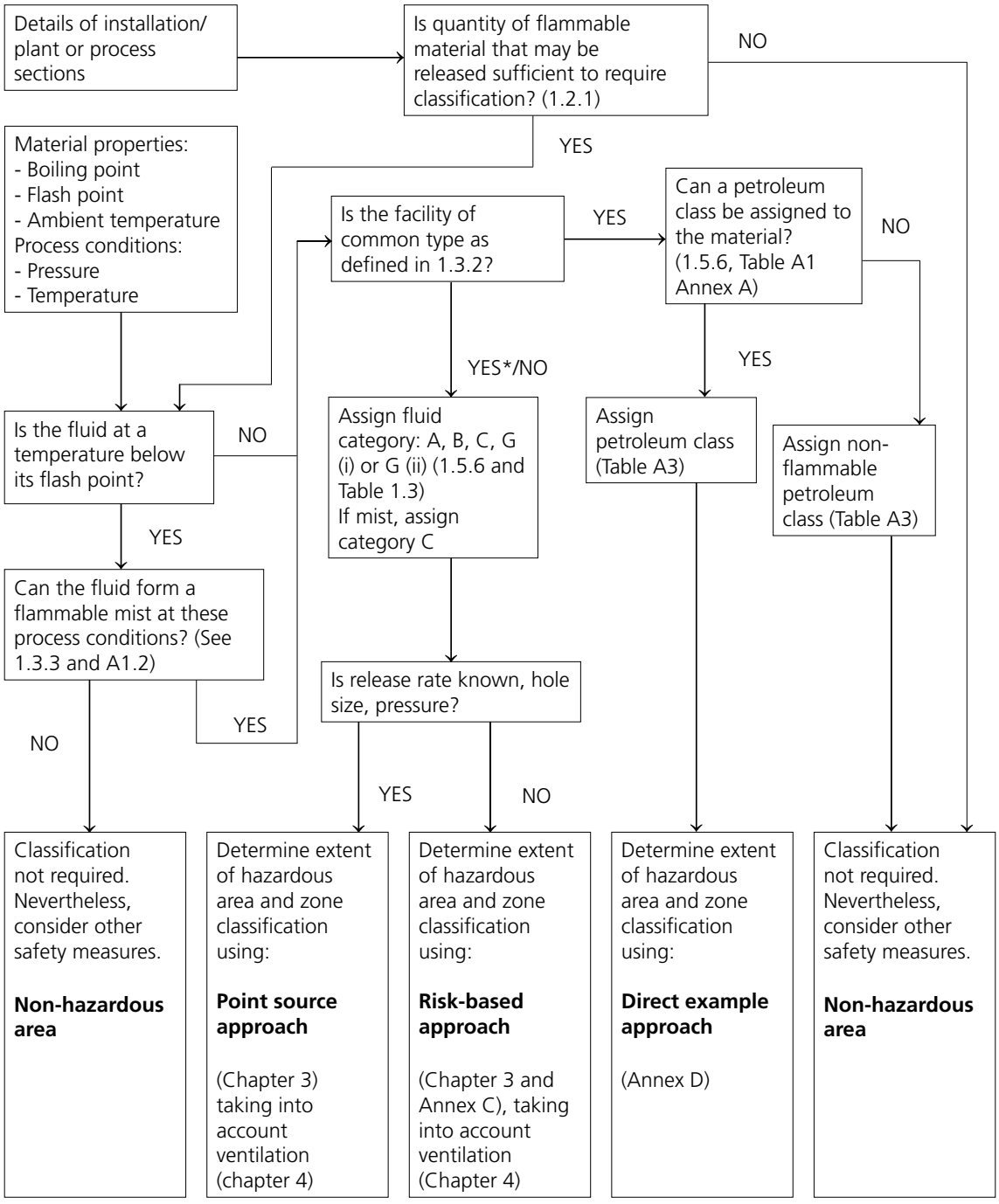
For process streams of less uniform volatility and where there are extremes in temperature and pressure, as in processing plant, a more rigorous calculation methodology should be used, referred to as the 'point source approach'. This methodology is presented in Chapter 3. An optional 'risk-based approach', covered in Annex C, may be used in conjunction with the point source approach when the release rate (hole size, pressure) is unknown. This approach may also be used to revise the extent of hazard radii.

1.3.2 Facilities of common type

Certain facilities of standard layout and design, handling flammable fluids, can be classified directly from typical examples. This is referred to as the 'direct example approach' and is presented in Annex D. These facilities may also be classified using the point source approach.

1.3.3 Mists and sprays

Flammable atmospheres may also be formed if flammable fluids are handled below their flash points. Although such fluids are normally regarded as non-hazardous, if released through a small hole under pressure they are capable of producing a mist or spray. They should be regarded as a category C fluid (see Table 1.3) generating a hazardous area as appropriate. (See Annex A.1.2).



* The point source/risk-based approach can be applied.

Figure 1.1: Application of Code