5.7 Classification of location

5.7.1 General

The location of category C, category D and category E substance pipelines should be classified in relation to population density along the route of the pipeline, to determine the operating stress levels and proximity distances from normally occupied buildings. The location of category A and category B substance pipelines need not be classified in relation to population density, but category B substance pipelines may require extra protection or be subject to a safety evaluation (refer to Annex A). Table 2 should be used for population density classification.

Table 1 — Classifying population density

Class 1 location	areas with a population density less than 2.5 persons per hectare
Class 2 location	areas with a population density greater than or equal to 2.5 persons per hectare and which may be extensively developed with residential properties, schools and shops etc.
Class 3 location	central areas of towns and cities with a high population and building density, multi-storey buildings, dense traffic and numerous underground services.
NOTE The measurement of population density is described in **5.7.3**.	

Additional factors should be considered when classifying pipeline location such as future development, topographical features in the area through which the pipeline passes and watercourses crossed or adjacent to the pipeline leading to areas of higher population density. In these and other comparable cases a more stringent classification of location should be considered, especially where the effects of a pipeline failure could be experienced by population centres outside the immediate vicinity of the pipeline.

5.7.2 Proximity to occupied buildings

5.7.2.1 The minimum distance between a pipeline conveying category A or category B substances and occupied buildings should be determined by the designer, who should take into account both access requirements during construction, and access requirements for maintenance and emergency services during operation.

5.7.2.2 At the pipeline feasibility study stage the initial route and population density assessment for pipelines conveying category C, category D or category E substances should be established using individual risk contours calculated for the pipeline. The minimum distance for routing purposes between a pipeline and occupied buildings should be no less than the distance to the 10 cpm risk contour, and in some cases ocal planning requirements may require this distance to increase t the 0.3 cpm individual risk contour.

In cases where individual risk contours are not available, the initial route and population density assessment for pipelines conveying category C, category D and category E substances should be established, taking account of the proximity to occupied buildings.

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At the pipeline feasibility study stage

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The minimum distance (in metres) for routing purposes between a pipeline having a design factor not exceeding 0.72, and occupied buildings should be determined from the following formula:

$$\text{Minimum distance} = Q\left(\frac{D^2}{32000} + \frac{D}{160} + 11\right)\left(\frac{P}{32} + 1.4\right)$$

where

D is the pipe outside diameter (in mm);
P is the maximum operating pressure (in bar);
Q is the substance factor (see Table 3).

The proximity distances for pipelines conveying category C substances at pressures less than 35 bar should be the same as those for the substance calculated at 35 bar.

Table 2 — Substance factors

Substance	Substance factor, Q
Ammonia	2.5
Ethylene	0.8
Hydrogen	0.45
Methane	0.55
LPG	1
NGL	1.25
Category C	0.3
NOTE Substances not specifically listed by name in Table 2 should be given the substance factor most closely similar in hazard potential to those quoted.	

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For pipelines conveying category C substances and having a design factor not exceeding 0.3, the initial route may be established by allowing a minimum distance of 3 m between the pipeline and occupied buildings. For pipelines conveying category D substances and having a design factor not exceeding 0.3 and a wall thickness greater than or equal to 11.91 mm the initial route may be established by allowing a minimum distance of 3 m between the pipeline and occupied buildings.

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For pipelines conveying category E substances and having a design factor not exceeding 0.3 and a wall thickness greater than or equal to 11.91 mm the initial routemay be established by allowing a minimum distance of 5.5Q m between the pipeline and occupied buildings.

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The minimum distances should finally be determined by taking into account factors including the hazardous nature of the particular substance being conveyed and the pipeline inventory, in accordance with the safety evaluation of the pipeline as required in section 5.7.2.1, and the individual risk contour levels indicated in section 5.7.2.2 above.

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5.7.3 *Population density*

5.7.3.1 For category C, category D and category E substance pipelines the population density should be calculated as the total of the average number of persons normally occupying buildings lying within the 0.3 cpm individual risk contours for the pipeline.

5.7.3.2 Where individual risk levels are not available, the population density for category C substance pipelines should be calculated as the total of the average number of persons normally occupying buildings within a strip centred on the pipeline of width three times the minimum distance given in **5.7.2.2** for any 1.6 km length of pipeline. For category D and category E substance pipelines the population density should be calculated as the total of the average number of persons normally occupying buildings within a strip centred on the pipeline of width eight times the minimum distance given in **5.7.2.2** for any 1.6 km length of pipeline.

5.7.3.3 The population density should be expressed in terms of number of persons per hectare. Measurement of population density should be based on a survey of normally occupied buildings including houses, schools, hospitals, public halls, and industrial areas. The population should be estimated following consultation with local authorities to assess the population level in the area concerned.

It is recommended that the boundary between class 1 and 2 in relation to population density is determined in a manner equivalent to that used in IGE TD/1 to determine the boundary between R and S areas. On this basis, the point at which the required degree of protection changes adjacent to the boundary between class 1 and class 2 areas should be determined as the point at which the population density exceeds the class 1 limit. In order to determine the boundary position, the population should be calculated within circles of diameter equivalent to 2 times the 0.3 cpm risk contour distance from the pipeline or 8 times the distance calculated in accordance with Section 5.7.2.2 above. By considering such circles in sequence outwards from the high density area, the circle within which the population density first falls below /above 2.5 persons per hectare should be determined. The centre of this circle should then be taken as the class1/2 boundary.

Occasionally the method of population density assessment may lead to an anomaly in classification of location such as may occur in a ribbon development area or for pipelines conveying toxic substances. In such cases consideration should be given to a more stringent classification than would be indicated by population density alone.

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