

KILKENNY FIRE and RESCUE SERVICE



Report: **GUIDANCE SPECIFICATION FOR
FIRE HYDRANTS & FIRE FIGHTING
WATER SUPPLIES**

Date: June 2005, Version 1.3.0

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KILKENNY FIRE and RESCUE SERVICE

GUIDANCE SPECIFICATION FOR FIRE HYDRANTS & FIRE FIGHTING WATER SUPPLIES



IRISH, BRITISH AND INTERNATIONAL STANDARDS

Standards affect all areas of fire safety and are continually being developed to protect and support both consumers and professionals. With regards fire related products, standards are created to cover new areas or are updated to encompass the latest technological advancements.

As standards continue to evolve to meet Irish, British, European and International criteria, it is crucial for specifiers/proprietors to know which standards apply to fire products. Standards provide common performance levels for both products and services. This ensures that a product is fit for the purpose it is intended. There are a large number of Irish, British and European Standards applicable to fire protection equipment and systems today.

At the time of going to press/publication the Irish, British and European Standards referred to in this specification were believed to be true and accurate. However, they are the current standards, which may be revised from time to time, so we would ask you to use our information as a basic guide only.

Compliance with this specification/guidance document does not of itself confer immunity from legal obligations.



LEGISLATION

Statutory Instrument No. 30 of 1981 **Fire Services Act, 1981 as amended**

Section 4

Offences

Any person who contravenes (by act or omission) any requirement of Part III of this Act or of any regulation under this Act or any notice to which this Act applies shall be guilty of an offence.

Section 5

Penalties

- 1) A person who is guilty of an offence by reason of a contravention of section 18(2), section 20 or section 20A or regulations made under section 37 shall be liable—
 - (a) on summary conviction, to a fine not exceeding \3,000 or to imprisonment for a term not exceeding 6 months, or to both, or
 - (b) on conviction on indictment, to a fine not exceeding \130,000 or to imprisonment for a term not exceeding 2 years, or to both.
- 2) Where a person is convicted of an offence referred to in subsection (1) and there is a continuation by the person of the offence after the conviction, the person shall be guilty of a further offence on every day on which the contravention continues and for each such offence shall be liable—
 - (a) on summary conviction, to a fine not exceeding \500 for each day on which the offence is so continued or to imprisonment for a term not exceeding 6 months, or to both, but if a person is convicted in the same proceedings of 2 or more such further offences, the aggregate term of imprisonment to which the person shall be liable shall not exceed 6 months, or
 - (b) on conviction on indictment, to a fine not exceeding \13,000 for each day on which the offence is so continued, or to imprisonment for a term not exceeding 2 years, or to both, but if a person is convicted in the same proceedings of 2 or more such further offences, the aggregate term of imprisonment to which he or she shall be liable shall not exceed 2 years.
- 3) A person who is guilty of an offence under this Act, other than an offence referred to in subsection (1) or (2), shall be liable, on summary conviction, to a fine not exceeding \3,000 or to imprisonment for a term not exceeding 6 months, or to both.
- 4) Where an offence under this Act is committed by a body corporate or by a person acting on behalf of a body corporate and is proved to have been so committed with the consent, connivance or approval of, or to have been facilitated by any neglect on the part of a person, being a director, manager, secretary or other officer of that body or a person who was purporting to act in any such capacity, that person shall also be guilty of an offence and shall be liable to be proceeded against and punished as if he or she were guilty of the first-mentioned offence.
- 5) Where the affairs of a body corporate are managed by its members, subsection (4) shall apply in relation to the acts and defaults of a member in connection with his or her functions of management as if he or she were a director of the body corporate.

Section 10

Functions of fire authorities

- 1) A fire authority shall have the functions assigned to it by or under this Act.
- 2) A fire authority shall—
 - (a) make provision for the prompt and efficient extinguishing of fires in buildings and other places of all kinds in its functional area and for the protection and rescue of persons and property from injury by fire, and
 - (b) establish and maintain a fire brigade, provide premises and make such other provision as it considers necessary or desirable for such purpose, and

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- (c) make adequate provision for the reception of and response to calls for the assistance of the fire brigade.
- 3) A fire authority shall, in the exercise of its functions under subsection (2), have regard (in addition to all other relevant considerations) to the nature of the fire hazards and the probable incidence and extent of fires in its functional area, the character of the area and the value of the property liable to be damaged by fires.

Section 18

General obligations with regard to fire safety.

- 1) This section applies to premises or any part thereof put to any of the following uses
 - (a) use as or for any purpose involving the provision of, sleeping accommodation, excluding premises consisting of a dwelling house occupied as a single dwelling;
 - (b) use as, or as part of, an institution providing treatment or care;
 - (c) use for purposes of entertainment, recreation or instruction or for the purpose of any club, society or association;
 - (d) use for purposes of teaching, training or research;
 - (e) use for any purpose involving access to the premises by members of the public, whether on payment or otherwise; and use for any other prescribed purpose, including
 - i. premises used as a factory within the meaning of the Safety in Industry Acts, 1955 and 1980;
 - ii. premises used as a store and subject to licensing under regulations made under the Dangerous Substances Act, 1972;
 - iii. a magazine, store or registered premises within the meaning of the Explosives Act, 1875; and
 - iv. an oil jetty within the meaning of regulations under the Dangerous Substances Act, 1972.
 - v. any workplace.
- 2) It shall be the duty of every person having control over premises to which this section applies to –
 - (a) Take all reasonable measures to guard against the outbreak of fire on such premises,
 - (b) Provide reasonable fire safety measures for such premises and prepare and provide appropriate fire safety procedures for ensuring the safety of persons on such premises,
 - (c) Ensure that the fire safety measures and procedures referred to in paragraph (b) are applied at all times, and
 - (d) Ensure, as far as is reasonably practicable, the safety of persons on the premises in the event of an outbreak of fire whether such outbreak has occurred or not.
- 3) It shall be the duty of every person, being on premises to which this section applies, to conduct himself in such a way as to ensure that as far as is reasonably practicable any person on the premises is not exposed to danger from fire as a consequence of any act or omission of his.
- 4) A fire authority may give advice in relation to fire safety to the owner or occupier of any premises or to any person having control over any premises.
- 5) Advice referred to in subsection (4)—
 - (a) may include a warning that a fire safety notice may be served under section 20 or that the owner or occupier may be liable to prosecution by reason of a contravention of a provision of this Act,
 - (b) may be given on behalf of the fire authority by an authorised person authorised for the purposes of this section by a fire authority in accordance with subsection (11) of this section, and
 - (c) may include recommendations, orally or in writing, to such persons concerning fire safety measures and procedures.
- 6) An authorised person may require a person having control over premises to which this section applies or to an owner or occupier of such premises—
 - (a) to carry out a fire safety assessment of such premises and to notify the fire authority of such assessment, and



- (b) to carry out works specified under subsection (9) to such premises within a period of time so specified.
- 7) An authorised person may issue a warning, in writing, concerning any matter arising out of fire safety procedures and measures on such premises.
 - 8) An authorised person may enter and inspect a premises to which this section or section 24 applies at all reasonable times for the purposes of this section.
 - 9) An authorised person may specify works to be carried out at a premises to which this section applies and may specify a period of time within which such works are to be carried out.
 - 10) Section 20(4) shall apply with any necessary modifications to works to be carried out under subsection (6).
 - 11) A fire authority may authorise a person to be an authorised person for the purposes of this section by an order made by a city manager or a county manager as the case may be.
 - 12) In this section 'authorised person' means a person appointed in accordance with subsection (11) of this section."

Section 29

Public water supply for fire-fighting

- 1) The functions of a sanitary authority for the provision of a supply of water shall extend to the supply of water for fire-fighting purposes and the provision and maintenance of fire hydrants at such places as the fire authority requires.
- 2) Where a fire authority represents to a sanitary authority that reasonable provision has not been made for a supply of water for fire-fighting purposes, the sanitary authority shall consult with the fire authority as to the measures required and shall take such measures as may be agreed.

Section 31

Damage to fire hydrant

- 1) Any person who interferes with, damages or obstructs a fire hydrant or any apparatus for drawing water from a main for the purpose of fire-fighting otherwise than in connection with operations of a fire brigade or for any purpose authorised by the sanitary authority shall be guilty of an offence.

Statutory Instrument No. 497 of 1997

Building Regulations, 1997

Second Schedule, Part B, Fire Safety

B5, Access and facilities for the fire service

Access and facilities for the fire service.

B5 A building shall be so designed and constructed that there is adequate provision for access for fire appliances and for such other facilities as may be reasonably required to assist the fire service in the protection of life and property.



SECTION 1.0 - Hydrant details

- I.1 **OUTLET:** Male, round thread, 62.5mm diameter, with cap chained to bolt of spindle flange. The depth of the hydrant outlet shall not exceed 300mm below finished ground level.
- I.1 **LOCATION:** As far as possible hydrants shall be located in the footpath or grass margin adjoining the roadway near the kerb. Where it is found necessary to locate the hydrant in the grass, the area around the box shall be periphery of the box. The surface box and concrete surround shall be kept over the level of the adjoining surface and weathered to prevent polluted water from entering the hydrant pit. Hydrant pits shall be constructed so as to be self-draining. The location of hydrants shall be such as shall allow easy fitting of a standpipe and ready access of fire appliance without causing obstruction to other vehicles.
- I.2 **DEPTH:** Spacer lengths under hydrant body shall be fitted to permit the top of false spindle being 75mm minimum to 225mm maximum below finished surface of footpath.
- I.3 **CHAMBER:** The containing chamber shall provide not less than 75mm clearance around the hydrant body.

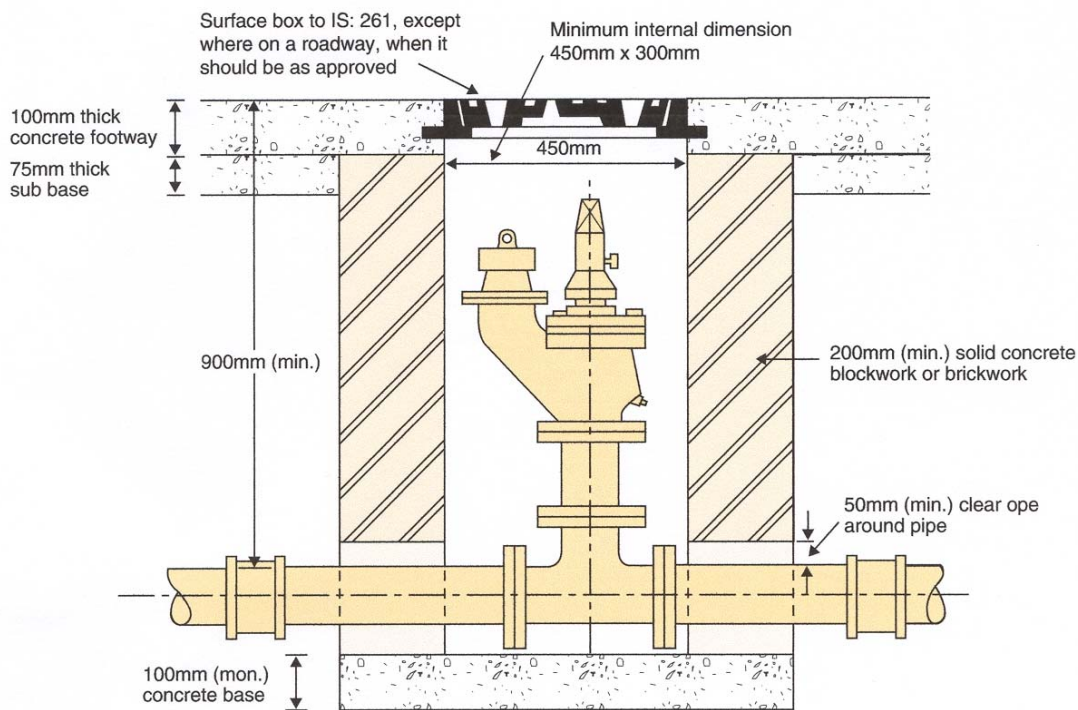


Figure I.0 – Hydrant Chamber

Hydrant chambers are provided with cast iron surface boxes, in compliance with the requirements of IS 261. The surface boxes are embedded in mortar on the chamber walls, and where any of the hydrants are located other than on a footway, driveway or roadway, are surrounded by 150mm concrete of 100mm in depth.



- 1.4 DRAINAGE: A 37.5mm minimum diameter drain from chamber to an open watercourse, shall be carried from a position at 50mm lower than the flanged base of the hydrant.
- 1.5 COVER: The hydrant cover box, with a 375mm x 225mm clear opening area, shall be placed centrally over the hydrant to permit freedom of affixing stand-pipe and operating key.
- 1.6 MARKER: A hydrant indicator plate, to BS 3251: 1976, shall be fitted on boundary wall or on marker against any fence provided at 450mm over footpath surface level. They should show the diameter of the watermain in millimetres on the upper part of the plate and the distance in metres of the marker from the hydrant on the lower part of the plate, as shown below:

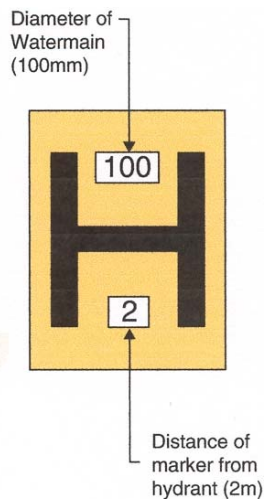


Figure 2.0 – Marker Plates

All the characters are black and the remainder of the front face should conform to colour reference No. 309 (Canary Yellow) of BS 381C.
 Some indicator plates may be present and are fixed to solid boundary walls, or where marker posts are utilised they should be constructed as shown below.

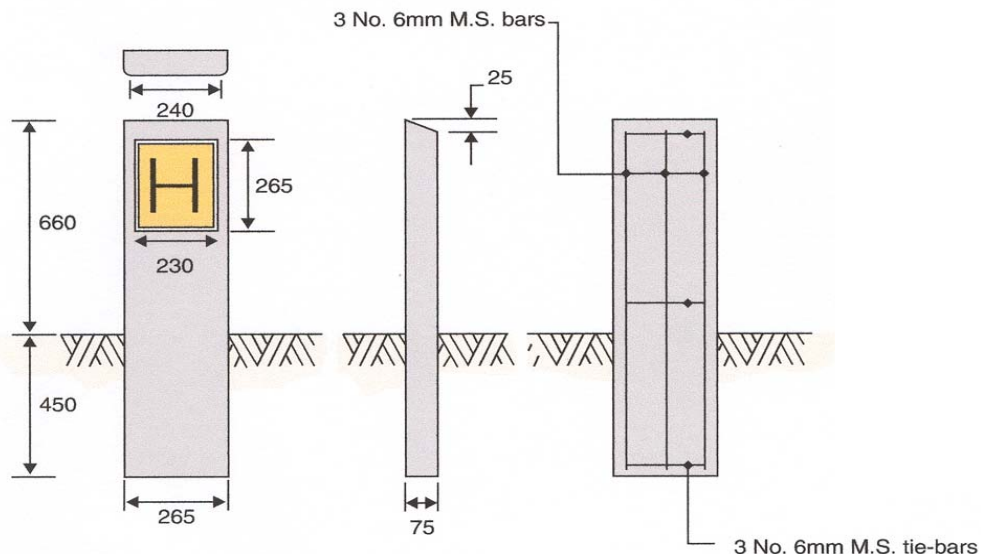


Figure 3.0 – Marker Plates

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- 1.7 SPACING: Fire hydrants should be located such that-
- (a) The distance from the building is not less than 6m or more than 46m;
 - (b) The distance from a hydrant to a vehicle access roadway or hard standing area for fire appliances is not more than 30m;
 - (c) They are distributed around the perimeter of the building having regard to the provision of access for fire appliances.
 - (d) Housing Estates / Residential Developments - Hydrants should be provided such that no house is more than 46 metres from a hydrant.

1.8 HYDRANT FLOW TESTING –

Kilkenny County Council Fire/Building Control Authority shall require for all fire safety certificate applications having a gross total internal floor area of 600m² or greater to demonstrate there is an adequate supply (volume) of firewater immediately available for the proposed application(s), either by means of an adequate number of fire hydrants, static storage or an open source of water.

On a 'fire safety' risk assessment basis building of any floor area may be requested to demonstrate there is an adequate supply (volume) of firewater immediately available for the proposed application(s), either by means of an adequate number of fire hydrants, testing of existing local/adjacent hydrants, static storage or an open source of water.

The flows (l/s) and pressure (bar) from the existing fire hydrants should be confirmed in writing to the assessing authority. Therefore demonstrating there is an adequate supply of water for use in an emergency. Fire-fighters must have immediate access to adequate supplies of water. Calibration certificates for any flow meters utilised shall be submitted with the test results.

Where a person is applying for a fire safety certificate it may be prudent for the applicant to seek specific advice, on a without prejudice basis, from the assessing Authority.

A building shall be so designed and constructed that there is adequate provision for access for fire appliances and for such **other facilities** as may be reasonably required to assist the fire service in the protection of life and property.



SECTION 2.0 - Water Supplies

2.1 WATER SUPPLIES - Residential/Housing Estate

Outcome: The supply of water is sufficient to meet firefighting purposes.

Fire Hydrants + Fire Water Main note (Residential/Housing Estate)

All fire hydrants shall be located in accordance with Technical Guidance Document B of Building Regulations, 1997 & Technical Guidance Document B of Building Regulations, 2006 Statutory Instrument 497 of 1997.

All fire hydrants to be installed in accordance with 'Recommendations for Site Development Works for housing works' DoEHLG, BS 5306: Part 1: 2006 Code of practice for fire extinguishing installations and equipment on premises – Part 1: Hose reels and foam inlets (*BS 5306: Part 1: 1976 has be withdrawn since May 2006*) and BS 9990: 2006 Code of practice for non-automatic fire-fighting systems in buildings, and marked in accordance with BS 3251: 1976 and installed in accordance with BS 750: 2006.

Final verification should be sought from the fire authority for agreed layout of all hydrants and the number of water supply connections to the firewater ring main, preferably there should be more than one and, preferably from supplies obtained from different mains.

<<<**Housing developments** with units of detached or semidetached houses of not more than two floors should have a water supply capable of delivering a minimum of eight litres per second (8 l/s) through any single hydrant.>>>

OR

<<<**Multi occupied housing developments** with units of more than two floors should have a water supply capable of delivering a minimum of 20 to 35 litres per second through any single hydrant on the development.>>>

The flows (l/s) and pressure (dynamic – bar) from the existing/adjacent/extended fire water main hydrants should be confirmed in writing to the fire authority, thus to demonstrate an adequate fire water main supply for the fire authority in the event of an emergency. Fire-fighters must have immediate access to adequate supplies of water.

2.2 WATER SUPPLIES - Commercial Development – Industry

Outcome: The supply of water is sufficient to meet firefighting purposes.

Fire Hydrants + Fire Water Main note (Commercial Development - Industry)

All fire hydrants shall be located in accordance with Technical Guidance Document B of Building Regulations, 1997 & Technical Guidance Document B of Building Regulations, 2006 Statutory Instrument 497 of 1997.

All fire hydrants to be installed in accordance with 'Recommendations for Site Development Works for housing works' DoEHLG, BS 5306: Part 1: 2006 Code of practice for fire extinguishing installations and equipment on premises – Part 1: Hose reels and foam inlets (*BS 5306: Part 1: 1976 has be withdrawn since May 2006*) and BS 9990: 2006 Code of practice for non-automatic fire-fighting systems in buildings, and marked in accordance with BS 3251: 1976 and installed in accordance with BS 750: 2006.



Final verification should be sought from the fire authority for agreed layout of all hydrants and the number of water supply connections to the fire water ring main, preferably there should be more than one and, preferably from supplies obtained from different mains.

The water supply infrastructure to any industrial estate should have a minimum nominal diameter of 150mm and have a water supply capable of delivering a minimum of 20 to 75 litres per second through any single hydrant, depending on acreage of industrial estate.

2.3 WATER SUPPLIES - **Transportation**

Outcome: The supply of water is sufficient to meet firefighting purposes.

Fire Hydrants + Fire Water Main note (**Transportation** – lorry/coach parks, multi storey car parks, service stations)

All fire hydrants shall be located in accordance with Technical Guidance Document B of Building Regulations, 1997 & Technical Guidance Document B of Building Regulations, 2006 Statutory Instrument 497 of 1997.

All fire hydrants to be installed in accordance with 'Recommendations for Site Development Works for housing works' DoEHLG, BS 5306: Part 1: 2006 Code of practice for fire extinguishing installations and equipment on premises – Part 1: Hose reels and foam inlets (*BS 5306: Part 1: 1976 has be withdrawn since May 2006*) and BS 9990: 2006 Code of practice for non-automatic fire-fighting systems in buildings, and marked in accordance with BS 3251: 1976 and installed in accordance with BS 750: 2006.

Final verification should be sought from the fire authority for agreed layout of all hydrants and the number of water supply connections to the firewater ring main, preferably there should be more than one and, preferably from supplies obtained from different mains.

All of these amenities should have a water supply capable of delivering a minimum of 25 litres per second through any single hydrant on the development or within a vehicular distance of 90m from the complex.

2.4 WATER SUPPLIES – **shopping, offices, recreation and tourism**

Outcome: The supply of water is sufficient to meet firefighting purposes.

Fire Hydrants + Fire Water Main note (**shopping, offices, recreation and tourism**)

All fire hydrants shall be located in accordance with Technical Guidance Document B of Building Regulations, 1997 & Technical Guidance Document B of Building Regulations, 2006 Statutory Instrument 497 of 1997.

All fire hydrants to be installed in accordance with 'Recommendations for Site Development Works for housing works' DoEHLG, BS 5306: Part 1: 2006 Code of practice for fire extinguishing installations and equipment on premises – Part 1: Hose reels and foam inlets (*BS 5306: Part 1: 1976 has be withdrawn since May 2006*) and BS 9990: 2006 Code of practice for non-automatic fire-fighting systems in buildings, and marked in accordance with BS 3251: 1976 and installed in accordance with BS 750: 2006.

Final verification should be sought from the fire authority for agreed layout of all hydrants and the number of water supply connections to the fire water ring main, preferably there should be more than one and, preferably from supplies obtained from different mains.

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Commercial developments of this type should have a water supply capable of delivering a minimum of 20 to 75 litres per second to the development.

2.5 WATER SUPPLIES – Education, health and community facilities

Outcome: The supply of water is sufficient to meet firefighting purposes.

Fire Hydrants + Fire Water Main note (**Education, health and community facilities**)

All fire hydrants shall be located in accordance with Technical Guidance Document B of Building Regulations, 1997 & Technical Guidance Document B of Building Regulations, 2006 Statutory Instrument 497 of 1997.

All fire hydrants to be installed in accordance with 'Recommendations for Site Development Works for housing works' DoEHLG, BS 5306: Part 1: 2006 Code of practice for fire extinguishing installations and equipment on premises – Part 1: Hose reels and foam inlets (*BS 5306: Part 1: 1976 has been withdrawn since May 2006*) and BS 9990: 2006 Code of practice for non-automatic fire-fighting systems in buildings, and marked in accordance with BS 3251: 1976 and installed in accordance with BS 750: 2006.

Final verification should be sought from the fire authority for agreed layout of all hydrants and the number of water supply connections to the fire water ring main, preferably there should be more than one and, preferably from supplies obtained from different mains.

<<Village Halls or the like>>

Should have a water supply capable of delivering a minimum of 15 litres per second through any single hydrant on the development or within a vehicular distance of 100m from the complex.

OR

<<Primary schools and/or Single storey health centres and/or the like>>

Should have a water supply capable of delivering a minimum of 20 litres per second through any single hydrant on the development or within a vehicular distance of 70m from the complex.

OR

<<Secondary schools, colleges, large health and community facilities and/or the like>>

Should have a water supply capable of delivering a minimum of 35 litres per second through any single hydrant on the development or within a vehicular distance of 70m from the complex.



SECTION 3.0– Static Storage

3.1 STATIC STORAGE

First and foremost, direct advice should be sought from a senior fire officer of Kilkenny Fire and Rescue Service.

The size of the static storage tank(s) shall be agreed in writing with Kilkenny Fire and Rescue Service. The design, location and layout of these tank(s) shall be agreed in writing with Kilkenny Fire and Rescue Service. Prior to commencement on-site, the Kilkenny Fire and Rescue Service requires that you submit all supporting calculations and drawings indicating the location and access to the static storage tank(s). The static storage tank(s) should be monitored for water level.

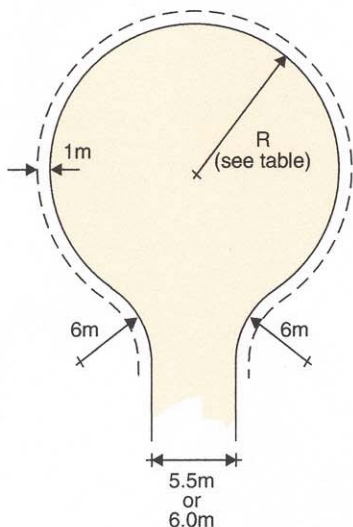
However, in brief we provide the following as guidance notes for static storage tanks –

1. The fire authority requires that a static storage tank(s) is provided on-site -
 - 1.1. To be sizing according to the risk assessment and
 - 1.2. To provide an adequate supply of water for fire fighting.
2. The area around the static storage tank(s) shall be a suitable designed hard-standing area for fire appliances, see guidance in Table 5.2 of Building Regulations, Technical Guidance Document, Part B. The heaviest Fire Appliance currently in Kilkenny Fire Authority operational area is the high reach appliance which is 18.5 tonnes.
3. If above ground tanks, the base of the static storage tank should a minimum of 1.0m off the adjacent hard-standing area, this will facilitate a gravity discharge of the entire tank contents to the eye of the main pump of the adjacent fire appliance.
 - 3.1. At least 2no. (two) instantaneous female fire brigade couplings shall be provided from the base of each static storage tank.
4. If below ground tanks, the [1] number of, [2] locations of, and [3] sized of access point to these tanks should be agreed in writing with Kilkenny Fire and Rescue Service prior to being placed.
 - 4.1. If a number of tanks are to be connected together, the sizes of and number of connections between tanks shall be agreed in writing with Kilkenny Fire and Rescue Service.
5. A methodology of monitored the contents, water level, of this static storage tank(s) will be required. We propose a low level alarm probe to be fitted at a high level position, typically at 80 % contents of the tank, this probe will be hard wired into the adjacent Fire Detection and Alarm System for continual monitoring. The graphics interface of the Fire Detection and Alarm System will be required. We also propose that a clear pipe be provided on the external façade of the tank(s) to allow for visual monitoring of the water level within the tanks.
6. All tanks shall be signed in accordance with BS 3251: 1976, Specification Indicator plates for fire hydrants and emergency water supplies.
 - 6.1. These signs should be of a permanent construction.
 - 6.2. They should be appropriately sized.
 - 6.3. The background and all text should be of photo-luminance properties.
 - 6.4. The signs should be erected in permanent fashion and all an appropriate height to be legible at all material times.
 - 6.5. The final layout of these signs with content should be agreed in writing with Kilkenny Fire and Rescue Service prior to manufacture and erection.



SECTION 4.0– Vehicle Access

4.1 RESIDENTIAL TURNING BAYS



Value of R which permits turning without reversing	
Vehicle Type	R metres
Private Car	6
Fire Engine	9
Refuse Vehicle	10
Furniture Removal	11

1m clearance for vehicle overhang shown dashed

NOT TO SCALE

Figure 4.0 – Turning Bays and Table

As extracted from Technical Guidance Document, Part B, the minimum size of turning circles for fire appliances are as specified in figure 5.0.

Appliance type	Minimum width of road between kerbs (m)	Minimum width of gateways between kerbs (m)	Minimum turning circle between kerbs (m)	Minimum turning circle between walls (m)	Minimum clearance height (m)	Minimum carrying capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	12.5
High Reach	3.7	3.1	26	29	4	16.25

Note:
 Use of these figures will cater for nearly all of the fire appliances in use at present. Some fire authorities use different sized appliances and it is therefore advisable that the relevant fire authority be consulted.

Note – the high reach platform in Kilkenny Fire Authority has a minimum carrying capacity of 18.5 tonnes.

Figure 5.0 – Vehicle access route specifications



SECTION 5.0– Standards and Engineering Codes

5.1 IRISH STANDARDS AND BRITISH STANDARDS

At the time of going to press, the Irish & British Standards referred to in this guide were believed to be true and accurate. However, they are the current standards, which may be revised, so we would ask you to use our information as a basic guide only.

SECTION 6.0 - References

- 6.1 **Recommendations for Site Development Works for housing works**, November 1998, available from Department of Environment Heritage and Local Government, Government Publications, Postal Trade Section, 4-5 Harcourt Road, Dublin 2, ISBN 0-7076-6163-3, Telephone number 01-6613111, approx price €12.70
- 6.2 **Technical Guidance Document B**, Building Regulations 1997, Statutory Instrument 497 of 1997, available from Department of Environment Heritage and Local Government, Government Publications, Postal Trade Section, 4-5 Harcourt Road, Dublin 2, Telephone number 01-6613111
- 6.3 **Technical Guidance Document B**, Building Regulations 2006, Statutory Instrument 497 of 1997, available from Department of Environment Heritage and Local Government, Government Publications, Postal Trade Section, 4-5 Harcourt Road, Dublin 2, Telephone number 01-6613111
- 6.4 **National guidance document on the provision of water for fire fighting**, UK Water, Local Government Association, 2nd Edition, May 2002
- 6.5 **Municipal Water related to Fire Fighting and Fire protection**, Chief Fire Officers Conference, Westport, Mayo 1986, Patrick J. Tobin & Co., Consulting Engineers, Galway.
- 6.6 **BS 5588 – Part 10 – 1997**, Code of Practice for shops, offices, industrial, storage and other similar buildings.
- 6.7 **BS 5588 – Part 11 – 1991**, Code of Practices for shopping complexes.
- 6.8 **NFPA 1142, National Fire Protection Association**, <http://www.nfpa.org>
- 6.9 **Fire engineering**, Chartered Institute of Building Services Engineers, CIBSE. (2003), 2nd Edition, Chartered Institute of Building Services Engineers: London, (CIBSE Guide E).
- 6.10 **Fire safety engineering; a reference guide**, Chitty. R. and Fraser-Mitchell. J. (2003), Building Research Establishment, Crown Copyright, (BR 459).