

S.R.21 2014 + A1: 2016

ANNEX E - AGGREGATES FOR USE AS HARDCORE UNDER CONCRETE SLABS AND FOOTPATHS

Introduction

Standard Recommendation 21:2014 + A1:2016 (S.R. 21) is the Irish national guidance on the harmonised standard, I.S. EN 13242:2002+A1:2007 (under revision), which is the standard that defines the characteristics and properties required of aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction. Ongoing revision, as and when required of S.R. 21 (and the parent standard) is within the scope of work of the National Standards Authority of Ireland (NSAI) Aggregates Panel. S.R. 21 contains six annexes, of which Annex E provides guidance for the specification and production of aggregates used as hardcore under concrete slabs and footpaths.

CE Marking to AVCP System 2+

As I.S. EN 13242: 2002 is a harmonised standard, material produced and marketed in accordance with this standard must be CE marked and the manufacturer must prepare and provide a Declaration of Performance (DoP).

The Declaration of Performance, which is a statutory requirement and must be sent out with each load despatched or otherwise be available on the manufacturer's website, should include the following statement with regard to the intended use: "*Unbound Granular Fill (Hardcore) for Use under Concrete Floors and Footpaths*".

Within I.S. EN 13242, only S.R. 21 Annex E material requires Assessment and Verification of Constancy of Performance (AVCP) system 2+ under the Construction Products Regulation 2011 (CPR), as a public confidence measure on foot of legacy pyrite issues. This requires an annual independent audit and certification of compliance by an independent (notified) certified body of the manufacturer's Factory Production Controls (FPC) as outlined in I.S. EN 13242:2002.

As the FPCs are part of the standard, not of S.R. 21, manufacturers seeking AVCP system 2+ certification are audited in respect of the entirety of the standard and consequently, are certified for all products under the standard (and S.R. 21) upon successful assessment of the FPCs. Thus, the certificate issued from the certified body states certification to the standard I.S EN 13242 and not to S.R. 21 Annex E.

Building Regulations

Under the National Building Regulations Technical Guidance Document (TGD) C – Site Preparation and Resistance to Moisture, hardcore for use under concrete floors and footpaths must comply with S.R.21 Annex E. An upcoming review of TGD C is expected to reference the most recent version of the S.R. and the placing details specified in the new standard I.S. 888:2016 - Code of Practice for the Procurement and Use of Unbound Granular Fill Hardcore Material for use under Concrete Floors (see overleaf).



**CONCRETE
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BETTER BUILT**



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Geological Assessment of the Quarry

The quarry deposit and S.R. 21 Annex E finished product stockpiles must be subject to initial and ongoing assessment, including geological, chemical and petrographic assessment as required. Following the initial assessment, an additional geological assessment must be carried out at least every 3 years, or when there is a major change in the lithology in the quarry, or as recommended by the professional geologist.

The professional geologist must be listed as a professional member of the Institute of Geologists of Ireland, or an equivalent professional body, with a minimum of 5 years experience of geological assessments of quarries and aggregates. The professional geologist must provide the quarry operator with a report with particular reference to potential limitations on the end use of the aggregates.

Properties of S.R. 21 Annex E Hardcore

Grading:

There are four different materials gradings, at least two of which are needed under every concrete slab or footpath (and within 500mm of each side of such concrete).

Name	Description
T0 Struc	Suitably graded structural unbound granular fill (hardcore) material (0/125 mm), for use at depths greater than 900 mm below the radon barrier/Damp Proof Membrane (DPM).
T1 Struc	Structural unbound granular fill (hardcore) material is an all-in graded aggregate (0-32 mm) or gravel (0/40 mm) to facilitate placing and compactability.
T2 Perm	Suitably graded gas permeable unbound granular fill (hardcore) material (4/40 mm) to facilitate the free movement of gas (radon) within the hardcore layer where a radon sump is required.
T3 Blind	Fine aggregate (0/4 mm, G _F 80), for blinding the top surface of the supporting granular fill material (T1 or T2) immediately below the DPM/radon barrier.

Note: Where gravel is used for T1 Struc or T2 Perm, it must contain at least 50% crushed faces.

Sulfur:

A representative sample of the finished aggregate product should be tested initially and then every production quarter to determine its total sulfur content. Total sulfur levels of the finished product trigger the following outcomes:

Total Sulfur >1%	Not suitable for use as hardcore under concrete floors and footpaths
Total Sulfur ≤ 0.1%	Suitable for use as hardcore under concrete floors and footpaths
Total Sulfur >0.1% and ≤ 1%	Petrographic assessment by a professional geologist required (as determined by the professional geologist). If the assessment identifies the presence of predominantly reactive forms of pyrite in potentially deleterious quantities, the aggregate is unsuitable for use as hardcore under concrete floors and footpaths.
	If the assessment identifies the presence of predominantly non-reactive forms of pyrite or other non-reactive sulfur containing minerals and where the professional geologist has no other concerns, the aggregate is deemed suitable (with respect to its petrography) for use as hardcore under concrete floors and footpaths.
	If the assessment identifies pyrrhotite, the aggregate is deemed suitable (with respect to its petrography) for use as hardcore under concrete floors and footpaths, only if its total sulfur limit is ≤ 0.4% and the professional geologist has no other concerns.

Other Properties:

Los Angeles (LA) Coefficent	LA ₃₀ (except T3 Blind)
Water Absorption (WA) Limit	WA ₂₄ 2 (except T3 Blind)
Magnesium Sulfate Soundness	MS ₂₅ (except T3 Blind)
Acid Soluble Sulfate	AS _{0,2}

Note: The sedimentary mudrock content of aggregates to be used as hardcore is limited to 10%. Recycled or manufactured aggregates cannot be used as hardcore.

Testing of S.R. 21 Annex E Hardcore

Initial Type Testing:

Initial type testing must be carried out on the aggregate before it is placed on the market and is required for new sources, or if there is a major change in raw materials or when the aggregate is to conform to a new requirement. The professional geologist may recommend a change in the frequency of any or all testing, from the more frequent testing regime set out in S.R. 21 Annex E to a lesser frequency, based on experience and knowledge of the material as long as the FPC requirements of the I.S. EN 13242 standard are complied with for product conformity with the standard, and also in order to maintain certification to the AVCP system 2+.

Frequency of Testing of Finished Aggregate Product:

Properties	Initial Type Test	Ongoing Conformity Testing**
Geometrical	Yes	1 per week (1/5 production days)
Los Angeles Coefficient	Yes	2 per year 1/6 calendar months)
Water Absorption (WA)	Yes	2 per year (1/6 calendar months)
Magnesium Sulfate Soundness	Yes	1 per year (1/12 calendar months)
Acid Soluble Sulfate	Yes	Quarterly (1/60 production days)
Total Sulfur	Yes	Quarterly (1/60 production days)
Geological* (if required)	Yes	Quarterly (1/60 production days)
Petrographic	If TS>0.1% and ≤ 1%	As required by Professional Geologist

* Geological testing must be carried out by the Professional Geologist

** The professional geologist may recommend a change in the frequency of testing.

Testing is based on production days, not calendar days, or of weekly, monthly and quarterly frequencies but not for periods of six months or over when calendar periods are required. The default period for testing where not mandated on the basis of cumulative production days achieved during a six month period shall be one test per six month period.

The professional geologist may change the frequency of testing based on current and previous test results and must provide a written declaration to the producer to this effect. The professional geologist should provide a statement of compliance as to whether or not the material is suitable for use as hardcore under for use under concrete floors and footpaths.

Where third party testing is required, as would be the case generally with chemical and petrographic testing as well as the more complex physical tests, a reputable and properly accredited laboratory should be used.

It is permissible for the professional geologist to assess the material for suitability across a range of products and standards simultaneously, as many tests are common across various specifications, both within I.S. EN 13242 and other aggregate standards for other uses, as long as the geologist's reports expressly addresses each product within the report, certifying suitability for use.

Delivery of S.R. 21 Annex E Hardcore

The delivery docket must include at least the following information:

- Designation:
 - Source and manufacturer
 - Type of aggregate
 - Aggregate size
- Date of dispatch
- Serial number of the ticket
- Reference to I.S. EN 13242
- A statement of compliance as appropriate:
 "SR21 Annex E – T0 STRUC";
 "SR21 Annex E – T1 STRUC";
 "SR21 Annex E – T2 PERM";
 "SR21 Annex E – T3 BLIND".

Placing of S.R. 21 Annex E Hardcore

I.S. 888:2016 - Code of Practice for the Procurement and Use of Unbound Granular Fill Hardcore Material for use under Concrete Floors outlines the requirements for the ordering, traceability and placing of hardcore for use under concrete floors and footpaths.

The general rules for use of the different types of S.R. 21 Annex E materials is as follows:

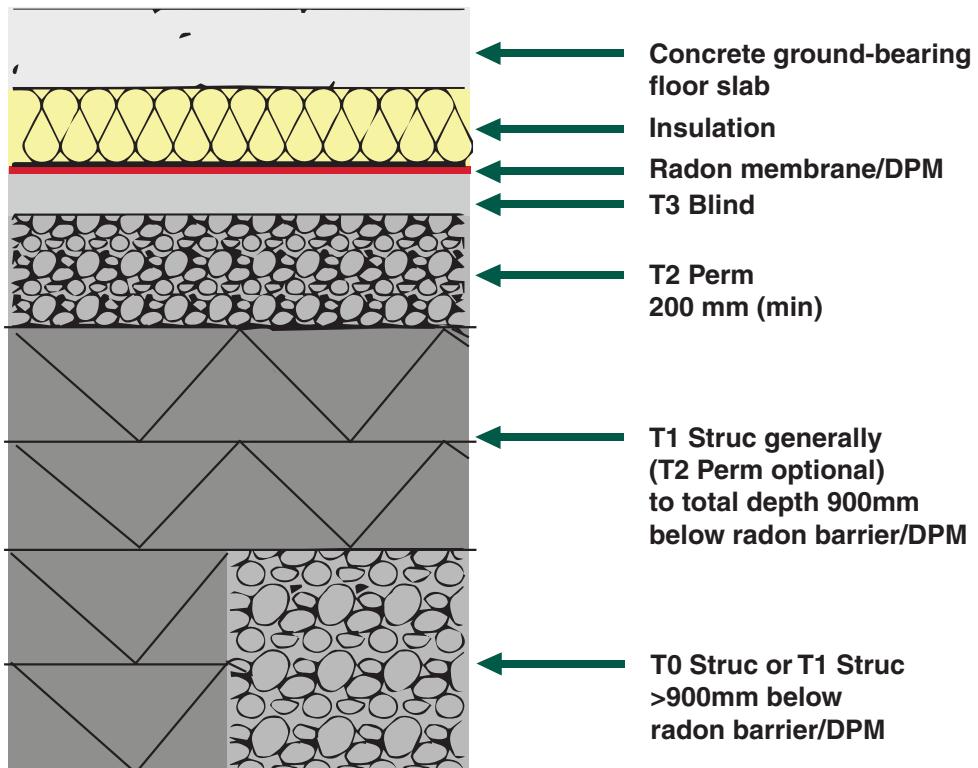
Name	Description
T3 Blind	Used in all cases to blind off the top layer of the hardcore and so is used immediately below the radon barrier/DPM, to mitigate the risk of puncture.
T2 Perm	Gas permeable material and must be used beneath the blinding layer and wherever a radon sump is present. The layer must not be less than 200mm in depth. For residential loading, 'T2 Perm' may be used as the sole fill material up to a maximum depth of 900mm or 'T1 Struc' may be used beneath it.
T1 Struc	Can be used beneath blinding layer where a gas permeable layer (T2 Perm) is not required or can be used under 200mm of 'T2 Perm' to any depth.
T0 Struc	May be used up to a level not closer than 900mm below the radon barrier/DPM. Thereafter 'T1 Struc' and/or 'T2 Perm' is used to make up the 900mm to radon barrier/DPM.

More detailed guidance on I.S. 888:2016 - Code of Practice for the Procurement and Use of Unbound Granular Fill Hardcore Material for use under Concrete Floors is available as a separate guidance note.

See back page for diagram.

Placing of S.R. 21 Annex E Hardcore (Continued)

Residential Detail (Radon Sump present)



Disclaimer: This document is for general guidance only. Readers are advised to consult the relevant standards, regulations and/or standard recommendations and obtain appropriate professional advice where necessary.

