CFA Guidance Note:
Deformation Controlled (Drop-in) Expansion Anchors

SUMMARY

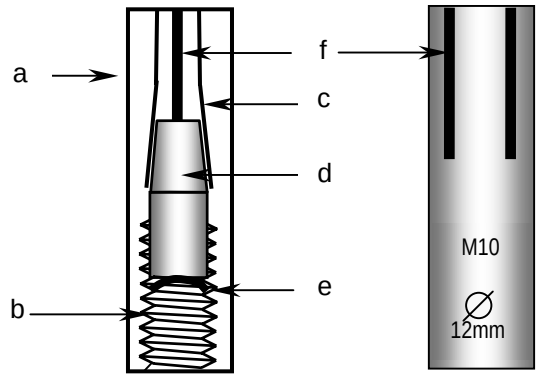
- Deformation controlled internally threaded expansion anchor
- Generally suitable for concrete only
- Use with hex bolts or threaded rod – not usually supplied
- M6 – M20
- Low to medium duty applications
- Carbon steel, and Stainless versions (A2 and A4)
- Flush set versions or deeper set
- Set without the fixture being in place
- Some have indication of correct setting
- Non - through fixed
- Not removable

1 INTRODUCTION

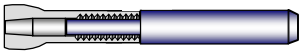
The type of anchor most frequently used in ceilings with drop-rods it goes under many names; the most common being “Drop-in”, also “Hammer-set”, “Flush”, “Wedge” and “Push in”. The term “Deformation Controlled” comes from the ETAG[1] system. This Guidance Note is intended to help specifiers understand how they work and to select the most appropriate type and size. It will also help contractors ensure their installers know how to set them correctly.

2 DESCRIPTION

The anchor comprises a shell (a) with an internally threaded section (b) leading to a tapered expansion section (c). A tapered expander plug (d) is pre-assembled within the shell and prevented from falling out prior to use by a plug retention system (e). Expansion is allowed by 4 slots (f) in the shell.

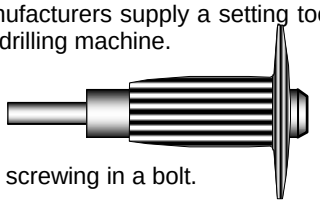


An integral part of this anchor system is the setting punch. The



dowel used to force the expander plug to the base of the anchor is designed specifically for the make and size of the anchor in question. They must not be used for other makes or sizes. Some manufacturers supply a setting tool which may be used in a hammer drilling machine.

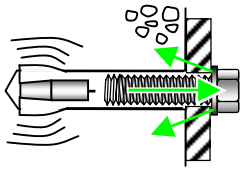
A hand guard is available from some manufacturers.



Drop-in anchors cannot be set by screwing in a bolt.

2.1 Operating principle

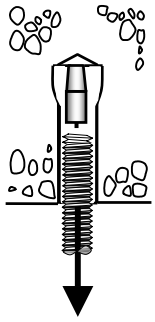
The anchor is expanded by the tapered plug being driven to the base of the anchor by a special punch. Full



expansion is assured once the shoulder of the punch meets the shell of the anchor. The expansion puts compressive forces into the base material so that extraction is resisted by a combination of keying and friction. The extent of the expansion achieved during the setting process establishes the maximum tensile capacity of the anchor, there is no “follow-up expansion” effect as with torque controlled anchors, it is therefore important that drop-in anchors are always fully set.

If a bolt is used to attach a fixture, as shown above, the usual relationship exists between the tension developed in the bolt by tightening (and reflected in the tightening torque) and the clamping force through the fixture. As long as the clamping force exceeds the tensile force applied by the fixture there will be no movement.

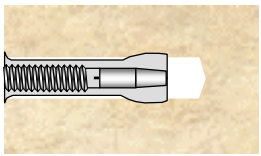
If used to support services via a drop rod there will be no need for tightening and no clamping force.



2.2 New Developments

The type shown opposite is the traditional design which has been popular for decades. New developments which have recently been introduced include:

Flanged shell
A flanged outer end to the shell prevents the anchor from being set anything other than flush with the surface even if the hole has been drilled deeper.



Setting in hard concrete
Also new is a system which acknowledges the fact that achieving full expansion in hard concrete is difficult. This design absorbs excess energy over and above that needed to achieve full holding capacity while allowing the setting punch to meet the shell of the anchor thus indicating correct setting.

Setting indicator
Increased emphasis on European Technical Approvals means that there is a need to demonstrate that an anchor is correctly set. This is done on some makes by a special shaping on the shoulder of the setting punch. This leaves an indentation on the front of the shell of the which will be visible for inspection until the anchor is hidden by a fixture.

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3 TYPICAL APPLICATIONS

The shallow embedment depth means that smaller diameters may be set in the cover above reinforcement. This lends itself to use in concrete deck undersides for the suspension of services, pipework, ductwork, cable tray, ceilings etc. (Some manufacturers quote reduced performance for anchors used in cracked concrete.) Drop-in anchors are also useful in floors where objects may be positioned over the already set anchor and are commonly used in walls for fixing bracketry for the support of services. M16 anchors are often used for scaffolding ringbolts. If used in edge beams, e.g. for stainless shelf angle, take care to respect minimum edge distances, see below.

4 SELECTI0N

Base material suitability
Drop-in anchors are designed for use in concrete. The shock loads introduced during the setting operation together with the high expansion ratio means that drop-in anchors will crack all but the strongest masonry so they should not be used in brick, stone or any sort of blockwork.

Dimensional limitations
All anchors need certain edge and centre spacing distances to carry full recommended loads. These are called “Critical” edge and spacing distances. While most anchor types may be set at closer “Minimum” edge and spacing distances with reduced performance, the shock loading and the relatively high local compressive stresses set up when setting drop-in anchors mean they may not be set closer to an edge than the critical edge distance which is usually three times the anchor length. Some makers allow closer spacing dimensions, with reduced loads, but not all – check with the manufacturer. The depth of concrete behind the anchor is also important, check the manufacturer’s recommended minimum structural thickness.

Bolt strength
The tensile strength of drop-in anchors is limited by the strength of the shell itself, so there is no point in specifying bolts or drop rods stronger than those recommended by the manufacturer.

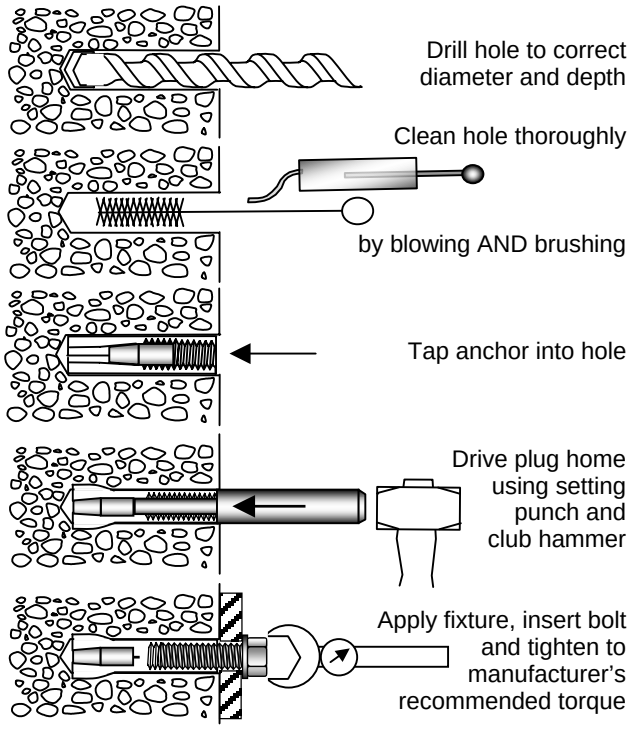
Bolt length
The choice of bolt length is critical with drop-in anchors. If bolts are used that are too short the thread engagement may be inadequate and the thread may strip under load, if too long the bolt thread may bind against the end of the thread within the anchor shell which may shear off when the bolt is tightened. Bolt length is determined by adding the thread length available within the anchor to the fixture thickness, including any packers.

Non-through fixing
Drop-in anchors are not designed to be fixed through the fixture, this must be born in mind when designing the installation. Clearance holes in fixtures may be based on the bolt diameter but should take account of marking out and drilling tolerances.

European Technical Approvals and selection software
Drop-in anchors are covered by two ETAG sections for different types of application. ETAG 001 Part 4[1] deals with those cases where the failure of a single anchor might lead to collapse of the structure, while ETAG 001 Part 6[3] covers “Anchors for multiple use* for non-structural applications” i.e. suspended services. Selection of anchors which have been awarded ETAs to either of these parts should be a simple process if manufacturer’s software is available.
*The definition of “Multiple use” is open to each member state. The UK definition is shown in the annex to ETAG 001 Part 6[3] and on the CFA website (go to ETA page).

5 INSTALLATION

A typical installation procedure is outlined below. The manufacturer’s instructions must always be followed.



Hole depth is important for all except flanged versions for which it may be deeper than the quoted minimum. To set flush the hole depth should be drilled to the length of the anchor. Some manufacturers recommend setting the anchor slightly back from the surface to ensure that the clamping force is directed into the base material and not through the shell of the anchor.
If packers are used under the fixture the engagement of the bolt may be affected, this can be checked on installation by counting turns, a minimum of eight turns is required.
Bolts should be tightened using a torque wrench. This will ensure the clamping force is reached and will protect both the bolt and anchor shell from being over tightened.

Removal
Drop-in anchors are virtually impossible to remove. If fixtures are to be removed and the flush anchor is to be hidden, then it should be set back from the surface at the outset so that the hole may be filled with a suitable filler.

References:
[1] Guideline for European Technical Approval (ETAG) 001 *Metal anchors for use in concrete. Part 4 Deformation controlled expansion anchors*. Download from www.eota.be/pdf/part4.pdf

[2] CEO Guidance Note: *European Technical Approvals for anchors used in construction*.
Download from www.fixingscfa.co.uk.

[3] ETAG 001 *Metal anchors for use in concrete. Part 6 Anchors for multiple use for non-structural applications*”.
Download from www.eota.be/pdf/etag001-part6correct.pdf.

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