



## Bolting guidelines

### Scope

These guidelines are produced by the New Zealand Speleological Society Incorporated (NZSS) for the use of its members while exploring caves in New Zealand. The NZSS does not propose it for use in other activities such as canyoning or climbing, nor in commercial applications. It reflects best practice for the use of bolts in New Zealand caves at the time of writing; however parts of this document may become obsolete because of future developments in equipment or technology.

### Introduction

The use of bolts for anchors is now common practice in New Zealand's caves; however bolts should not be used indiscriminately, since placing bolts amounts to a permanent modification of the cave. Bolts are used where rigging with natural protection would not provide safe anchors.

Before bolting always seek the permission of the land owner, or in the case of public conservation land, the Department of Conservation (unless bolting is provided for in the relevant park plan or CMS document). The Department of Conservation should consult the NZSS for information on bolting in caves.

All bolts should be treated with caution, as with any fixed anchor. Cavers use all fixed rigging, including bolts at their own risk.

### Specifications

For permanent fixed anchors in marble caves, the following are minimum requirements.

- The standard bolt for use in caves is an expansion sleeve (collar and wedge) type, though other bolt types may be suitable also.
- The recommended minimum bolt size is 75mm length x 10mm diameter.
- The material quality should be stainless steel of SAE grade 316, or a more corrosion resistant type.
- Hangers must also be made of SAE grade 316, or a more corrosion-resistant material.
- All parts of the anchor should be rated to a minimum shear strength of at least 20 kN.
- All holes should be over-drilled so the bolt can be banged in later if no longer required.

Glue-in anchor bolts are also suitable, and are essential in soft limestone. These should be a minimum of 100mm long and 10mm in diameter. Expansion bolts as specified above have been effective in some West Coast and Waitomo limestone, and in the Mt Arthur Tableland caves, but should be used with caution in limestone.

Note that some manufacturers may show ratings lower than the minimum shear strength because they incorporate safety factors into the strength rating.

Higher corrosion resistant (HCR) materials are being developed and will in time supersede grade 316. Currently these include HCR grades such as 904L and duplex stainless steels such as PLX (grade 2304).

### Removeable bolts

These are available in various types, including:

- Full-sleeve wedge bolts of certain types.
- Screw-in bolts.
- Push-pin bolts such as the Petzl "Pulse" type.

The advantage of all removeable bolts is that they can be placed during exploration, and then retrieved if no longer required. The holes left behind are inconspicuous, and provide the options of placing a permanent bolt, or revisiting the cave using the original removeable ones.

Removeable bolts are particularly appropriate for rescues and rescue exercises, when otherwise significant numbers of bolts may be placed for a single operation that are not needed for exploration of the cave.

### Variations

Smaller stainless steel expansion bolts of 8 mm diameter may be suitable in marble, providing:

- The bolts are used in pairs, and placed to enable the load to be shared across both;
- The rock is clearly reliable and free from fractures, and;
- The bolt has a minimum rated strength of at least 12 kN in shear.

Bolts of 8 mm diameter are not suitable for rescue, and if encountered in a rescue may have to be replaced. Generally, the 10 mm size is best for all rigging.

Titanium is also suitable for permanent anchors, but its cost is prohibitive for most purposes.

Most-other materials including zinc plated steel and galvanised steel are not acceptable due to their susceptibility to corrosion, often leading to a short life span. Using these materials puts future cavers at risk. However, these may be used for aid climbing (see below).

In particular the common zinc-plated Ramset Dynabolts should never be used for fixed anchors as they are particularly susceptible to corrosion. The full-sleeve Dynabolt design is not preferred, even in stainless steel options, because the bolt size is two millimetres smaller than the hole size.

Ancillary hardware such as hangers, rings, and chains must be commercially made and of stainless steel 316 grade, or a higher corrosion resistant material. Galvanised chain links, which have been used as an alternative to hangers, are not acceptable because they exert leverage on the anchor, are unrated, and are susceptible to corrosion.

Using the right equipment in the first instance will save time and money in the long term by not having to re-bolt cave pitches later, and will avoid the proliferation of obsolete bolts.

### Placement

Placing anchor bolts is fraught with difficulties and can best be learned under the supervision of someone with extensive experience. The following points should be noted for the use of expansion bolts:

1. The rock around the bolt must be sound, as gauged by hitting it with the hammer.
2. Anchors generally comprise two bolts. For “pull-through” caves, bolts which are linked with integrated stainless steel chain to provide a “focused” anchor are preferable.
3. The two bolts must be separated by about 20 cm — use a hand-span from thumb to little finger as a guide.
4. Bolts must be placed perpendicular to the rock surface, which ideally is vertical.
5. Bolts must be tensioned according to the manufacturer’s instructions.
6. There should be no more 10 mm exposed thread above the nut after the bolt is tensioned.
7. Hangers must sit squarely and flush with the rock surface.
8. Nuts must be tight and should be secured with a thread-locking adhesive, to avoid them spinning off from vibration.
9. Bolts that turn in the hole, or have a galled nut, or a sleeve overriding the shank, must be replaced.
10. Holes must be over-drilled so that the bolts can be hammered in if no longer required.

## **Aid climbing**

Occasionally cavers use bolts for aid climbing underground. As these bolts are not fixed anchors and are not used in the long term, the exploration team may decide on a different type of bolt, based on lower cost or removability.

Options include 8 mm galvanised steel bolts, full-sleeve expansion bolts, screw-in bolts, and other removable bolt types.

If non-removable bolts are used on aid climbs, the holes must be over-drilled so they can be hammered in after use. Leaving a trail of bolts protruding from the rock is unacceptable.

## **Bibliography**

### ***British Standards Institution:***

BS EN 959:2007 Mountaineering equipment. Rock anchors. Safety requirements and test methods

### ***International Climbing and Mountaineering Federation (UIAA)***

1. UIAA 123: Rock anchors

2. [https://www.theuiaa.org/documents/safety/UIAA-WARNING-ABOUT-CLIMBING-ANCHORS-FAILURES\\_Dec15.pdf](https://www.theuiaa.org/documents/safety/UIAA-WARNING-ABOUT-CLIMBING-ANCHORS-FAILURES_Dec15.pdf)

### ***New Zealand Alpine Club: Bolting Standards (for Route Developers) 2025***

[https://alpineclub.org.nz/parkside/wp-content/uploads/2016/07/NZAC-3.-Bolting-Standards\\_Dec-2017.pdf](https://alpineclub.org.nz/parkside/wp-content/uploads/2016/07/NZAC-3.-Bolting-Standards_Dec-2017.pdf)

### ***New Zealand Canyoning Association: Bolting Code of Practice***

<https://nzcanyoningassociation.org/resources/#boltingcode>

### ***New Zealand Speleological Society Inc: Minimum Impact Code***

[https://cdn.prod.website-files.com/64f515db910e9870db8d575f/66542032b039b38ad15e7ff1\\_NZSS%20Minimum%20Impact%20Code.pdf](https://cdn.prod.website-files.com/64f515db910e9870db8d575f/66542032b039b38ad15e7ff1_NZSS%20Minimum%20Impact%20Code.pdf)