Government of Western Australia
North Metropolitan TAFE

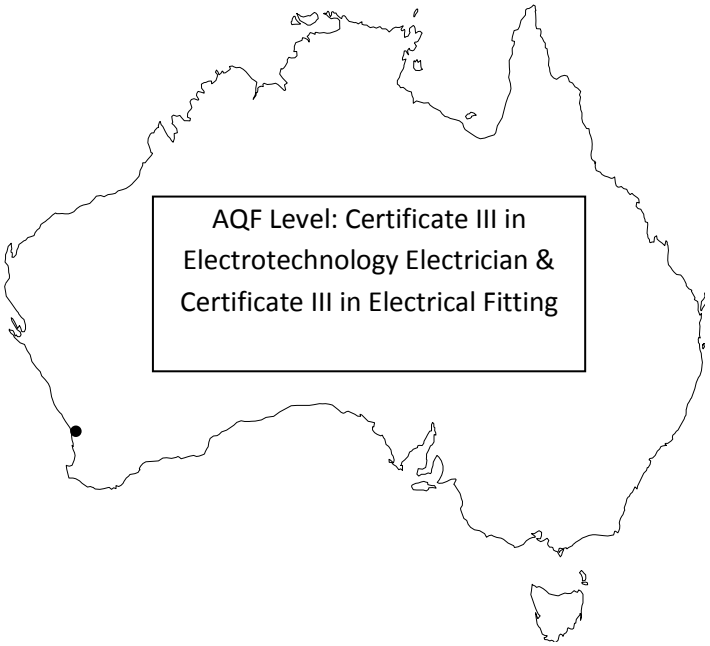
UEE11 Training Package Support Material
(Non-Endorsed Component)

Based on:
National Electrotechnology Industry Standards

Resource Book

UEENEEE105A

Fix and Secure Electrotechnology Equipment



North Metropolitan TAFE
V8 August 2018

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Acknowledgements

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Disclaimer:

Certificate III in Electrotechnology Electrician UEE 30811

UEENEEE105A – Fix and secure electrotechnology equipment

C O N T E N T S

Training Achievement Record:

References

- The Occupational Safety and Health Act 1984 (WA).available at *www.worksafe.wa.gov.au*
- The Occupational Safety and Health Regulations 1996 (WA). available at *www.worksafe.wa.gov.au*
- Electrical Wiring Practice – Volume 1 (7th ed.) Pethebridge & Neeson
- Code of Practice – Safe electrical work on low voltage electrical installations *www.commerce.wa.gov.au/**energysafety***
- St John's First Aid and C.P.R. Available library and or St Johns .
- Wiring Rules AS/NZS 3000:2018

Required Skills and Knowledge

UEENEEE105A – Fix and secure electrotechnology equipment

Prerequisite Unit(s)

UEENEEE101A	Apply Occupational Health and Safety regulations, codes and practices in the workplace

ELEMENT	PERFORMANCE CRITERIA	
1 Prepare to fix and secure equipment.	1.1	OHS procedures for a given work area are identified, obtained and understood.
	1.2	OHS risk control work preparation measures and procedures are followed.
	1.3.	The scope of work to be undertaken is obtained from documentation or from work supervisor.
	1.4	Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.
	1.5	Sources of materials that may be required for the work are identified and accessed in accordance with established procedures.
	1.6	Fixing devices are selected for their suitable ability for the environment, the load they are to support and substratum's into which they are to be installed.
	1.7	Supporting accessories/equipment is selected for suitability for the environment and ability to support and protect from damage that which they are intended to support.
	1.8	Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
2 Install fixing and support devices.	2.1	Electrical isolation is arranged where work is within arm's reach of exposed conductive parts, plant or machinery in strict accordance OHS requirements and procedures.
	2.2	Other OHS risk control measures relevant to the work site are followed.
	2.3	Fixing devices are installed in accordance with manufacturer instructions.
	2.4	Support accessories/equipment is install accurately and to comply with technical standards and job specifications.
	2.5	Work is carried out efficiently without waste of materials or damage to apparatus, circuits, the surrounding environment or services and using sustainable energy principles.
3. Complete fixing and support work.	3.1	OHS risk control work completion measures and procedures are followed.
	3.2	Work site is tidied and tools and equipment cleaned and securely stored.
	3.3	Appropriate personnel are notified of the work completion.

UEENEEE105A - Required Skills and Knowledge Topics:

KS01-EE105A Fixing and support devices/techniques

Evidence shall show an understanding of accessories and support and fixing device and methods and their use to an extent indicated by the following aspects:

T1. Device for securing and mounting electrical/electronic/instrumentation/refrigeration/ air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories to hollow walls encompassing:

- types and safe application of devices for hollow wall fixing and support
- methods/techniques used to fix/support to wood, hollow wall, masonry blocks, plasterboard, panelling
- types and safe application of fixing devices used in the electrotechnology industry for wood and hollow wall structures (wood screws, coach bolts, self-tappers, self drilling, metal thread, hollow wall anchors, behind plaster brackets, stud brackets, plasterboard devices, toggle devices)
- types of tools used for hollow wall fixing and supporting.
- using various fixing methods to fix/support to hollow walls.

T2. Device for securing and mounting electrical/electronic/instrumentation/refrigeration/ air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories to solid walls encompassing:

- types and safe application of devices used for solid wall fixing and support
- methods/techniques used in to fix to masonry and concrete structures
- fixing devices used in the electrotechnology industry for solid wall structures (wall-plugs, expanding concrete fixing devices, gas powered fixing tools, powder actuated fixing tools, loxins, dynabolts, chemical devices)
- regulatory requirements for use of powder fixing tools.
- hand and power tools used in fixing and supporting accessories
- using various fixing methods to fix/support to solid walls

T3. Device for securing and mounting electrical/electronic/instrumentation/refrigeration/ air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories to metal fixing encompassing:

- accessories that may be fixed to metal (saddle clips, conduits, brackets, switches)
- techniques for fixing to metal
- fixing devices: coach bolts, self-tappers, metal thread bolts, hollow wall anchors, rivets
- fixing tools - spanners, screwdrivers, power screw drivers, pop riveters, files, reamers
- OH&S issues related to drilling, cutting, eye protection, metal filings, swarf, noise
- Using power drills, drill bits, change drill speeds.
- Install a fixing device and accessory capable of supporting up to 20 kg on the metal plate.

T4. Securing and mounting electrical/electronic/instrumentation/refrigeration/ air-conditioning/telecommunications accessories for supporting, fixing and protecting wiring/cabling/piping and functional accessories using fixing adhesives and tapes encompassing:

- types and safe application of using adhesives and tapes as fixing devices (load limits of different commercial products)
- accessories that may be fixed using adhesives and tapes
- techniques for the application of adhesives and tapes
- tools used to apply and cut adhesives and tapes
- hazards and safety measures when working with adhesives and chemical fixing devices (fumes, cutting, eye protection, physical contact, hand protection, ingestion)

Workplace Rules:

Rule 1	Follow the instructions
Rule 2	Tolerate ambiguity
Rule 3	Meet your obligations

Note: This information and current details of critical aspects for each competency standard unit (CSU) in this qualification can be found at the Australian Training Standards website: www.training.gov.au.

Q-TRACKER REQUIREMENTS:

100 hours of practical training.

1. Performance requirements:

1a. Related to the following elements:

1. Prepare to fix and secure equipment.
2. Install fixing and support devices.
3. Complete fixing and support work.

1b. For each element demonstrate performance:

− across a representative body of performance criteria,
− on at least 2 occasions,
− autonomously and to requirements,
− within the timeframes typically expected of the discipline, work function and industrial environment.

2. Representative range includes the following:

All listed tasks related to performance across a representative range of contexts from the prescribed items below:

The minimum number of items on which skill is to be demonstrated:

Group No		**Item List**
A.	All of the following: **Using tools**	• HSS drill bits • threading taps • masonry drills • hammer drill • measuring tools
B.	At least three of the following: **Fixing media**	• hollow wall (cavity fixing) • brick • concrete • steel • plasterboard
C.	At least five of the following: **Fixing devices**	• direct fixing to timber • *dynabolts* • PVC plugs • wooden plugs • *loxins* • chemical fasteners • toggle bolts • plasterboard devices • explosive tool studs • masonry nails • adhesives / tapes
D.	All of the following: **Loading**	Select types of fittings for different weight loads eg. < 5 kg. < 20 kg. < 50 kg and use suitable fittings for different environmental conditions.

UEENEEE105A – Fix and secure electrotechnology equipment

Learning and Assessment Plan

Name of Lecturer: _____

Contact Details: _____

Delivery Mode/s: ☑ Face to Face ☐ On-Line ☐ Blended Delivery ☐ Other

Using:

Session	Nominal Duration	**Program of Work (Topics to be covered)**	Primary Reference
1	½ hour	Introduction / Overview	Resource Book
2	½ hour	Isolation Procedure	Resource Book
3	2 hours	Hollow Wall	Resource Book
4	½ hour	Hollow Wall Questions	Resource Book
5	2 hours	Solid Wall	Resource Book
6	½ hour	Solid Wall Questions	Resource Book
7	2 hours	Metal	Resource Book
8	½ hour	Metal Questions	Resource Book
9	1 hour	Adhesives and Tapes	Resource Book
10	½ hour	Adhesives and Tapes Questions	Resource Book
11	3 hours	Practical Activity 1 (Hollow Wall)	Resource Book
12	3 hours	Practical activity 2 (Solid Wall)	Resource Book
13	1 hours	Practical activity 3 (Metal)	Resource Book
14	1 hour	Assessment	

I acknowledge that I have received and read this Learning and Assessment Plan

Student Name:_____ Signature: _____

Date: _____ ___

Lecturer Name	Lecturer Signature	Date

Assessment Strategy

Conditions of Assessment:

Normally learning and assessment will take place in an integrated classroom/ laboratory environment.

It is essential to work through the worksheets and activities in this workbook and follow the guidance of your lecturer. The worksheets and practical activities will provide the essential skills and knowledge outlined in this Unit and assist you in achieving competency.

Assessment Methods:

Written Knowledge Assessment – based on the Required Skills and Knowledge (RSAK). You must achieve a mark of 75% or more in this assessment.

Observed Skills Assessment – based on the Elements and Performance Criteria of this Competency Unit UEENEEEE105A. You must achieve a mark of 100% in this assessment.

On-Job-Training:

It is expected that the off-job component of this competency unit will be complemented by appropriate on-job development involving exposure to re-occurring workplace events and supervised experiences. (See Work Performance Tasks.) You are required to log your on-the-job training in your 'Q-Tracker' apprentice work book and on www.qtracker.com.au account.

Sufficiency of Evidence:

In all instances competency is to be attributed on evidence sufficient to show that a person has the necessary skills required for the scope of work. These include:

- Task skills - performing individual tasks
- Task management skills - managing a number of different tasks
- Contingency management skills - responding to irregularities and breakdowns in routines
- Job/role environment skills - dealing with the responsibilities and expectations of the work environment including working with others.

Evidence must demonstrate that an individual can perform competently across the specified range of activities and has the essential knowledge, understanding and associated skills underpinning the competency.

LABORATORY INSTRUCTIONS

Students working in laboratories at North Metropolitan TAFE Campus's do so on the condition that they agree to abide by the following instructions. Failure to observe the safety instructions will result in IMMEDIATE SUSPENSION.

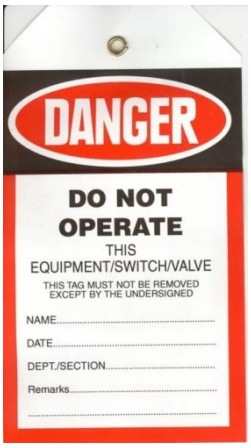
1. No circuit is to be plugged in or switched on without the specific permission of the lecturer in charge of the class. A circuit must be switched off, isolated and tested for ZERO VOLTS before any supply leads are removed. The DANGER TAG PROCEDURE must be used at all times.
2. Do not leave any circuit switched on any longer than necessary for testing. Do not leave any circuit switched on unattended.
3. Check each item of equipment before using. Report any broken, damaged or unserviceable equipment to your Lecturer.
4. All wiring must be disconnected at the end of each practical class or as each project is completed.
5. Make all connections in a safe manner with an appropriate connecting device. Unshielded 4mm banana plugs are not to be used for wiring.
6. Switch off, remove the plug from the socket and attach your DANGER TAG to the plug top before working on any project. It is not sufficient to simply turn the switch off.
7. When disconnecting your wiring from a connection made under a screw, undo the screw to remove the wiring, do not cut the wire off.
8. Observe the correct colour code for all wiring projects.
9. Test your circuit for short circuits with your multimeter before asking your Lecturer to switch circuit on. Test the Tester before and after EACH test.
10. Where an activity sheet is issued for a project, complete each step in the Procedure before moving to the next step. Advise your Lecturer when you have completed the activity.
11. Draw ALL DIAGRAMS in PENCIL so that they can be easily changed or corrected. Mark off each connection on your diagram as it is made.
12. Check the range before taking a reading with a multimeter.
13. Make sure that it is YOUR plug before inserting plug into an outlet.
14. Always switch multimeter OFF, or to the highest possible AC VOLTS range when you have finished using it.
15. Report any unexpected situations or events to your Lecturer.

Student's Signature _____ Date: _____

DANGER TAG PROCEDURE for ELECTRICAL TRADE LABORATORIES

THE FOLLOWING PROCEDURE IS COMPULSORY

1. The student is to attach a DANGER TAG on to the plug top of the project lead before proceeding with the allocated project. A danger tag must be attached to the plug top at all times, when the lead is NOT plugged into the supply outlet. Plug tops or leads are not to be connected to the supply outlet WHILE A DANGER TAG is attached.



2. The student is to assemble the project according to project instruction procedure and lecturer's directions in its isolated and de-energised state and report to the lecturer as necessary and on completion.

3. The lecturer is to:-
   a. Check the project for safety and
   b. Ensure that the student has performed a safety check, including a short circuit test using the recommended procedure.

4. When the lecturer is satisfied that the project is safe to connect and energise the lecturer is to instruct the student to REMOVE the DANGER TAG from the plug top.

5. The student is to plug in the project and switch it on in the presence of the lecturer.

6. The lecturer is to determine whether or not the project is operating satisfactorily.

7. If the project operates satisfactorily the student may take measurements using correct meters with regard to the safety risks associated with using the particular item of test equipment including;
   a. Selecting correct meter function,
   b. Holding meter probes correctly during measuring with fingers behind knurls (finger guards) at all times.

   This is to be done under general supervision of lecturer. The student is NOT to modify, disassemble or carry out ANY unsafe act.

8. If the circuit is to be modified the student must:
   a. Switch the circuit off,
   b. Disconnect the project from the supply,
   c. Attach the DANGER TAG to the plug top,
   d. Report to the lecturer for instructions,
   e. In the lecturer's presence the student is to:-
   f. TEST and VERIFY for ZERO VOLTAGE.
   g. Restart the DANGER TAG procedure from step 2 above.
9. When the student is satisfied that the project has been completed the student is to:-
   a. Switch the project off,
   b. Remove the plug,
   c. Replace the DANGER TAG on the plug top,
   d. Report to the lecturer for instructions,

   In the lecturer's presence the student is to:-
   e. TEST and VERIFY for ZERO VOLTAGE.

   The lecturer is then to instruct the student to:-
   f. Disassemble the project
   g. Remove the DANGER TAG and store the equipment in its designated place.

Failure to follow Danger Tag Procedures when working on practical activities and practical assessments will result in a '**Not yet competent'** comment recorded for this Unit of Competency – UEENEEE105A

Student's Signature _____ Date: _____

Fix and secure electrotechnology equipment

Task:

To identify common fixings and fastenings used in electrical installation work and use them to safely fix electrical equipment in position in a variety of situations.

Why:

Electrical equipment needs to be fixed in position in different situations including to wood, masonry, plaster sheet, concrete, stone, and steel beams. You need to know what types of fixings are available for a particular situation, what to call them, and how to install them safely and correctly.

To Pass:

1. You must correctly answer the questions on the Work Sheets provided and achieve a mark of 75% or more in a knowledge test for each Required Skills and Knowledge (RSAK) topic.

2. You must satisfactorily complete the set activities and laboratory tasks.

3. You must achieve 100% in a final practical competency assessment.

Equipment

Nil

Resources

- Electrical Wiring Practice – Volume 1 (7th ed.) Pethebridge & Neeson
- AS/ANZ 3000:2018 Wiring Rules.

Fix and secure electrotechnology equipment

Suggested Self-Study Guide

1. Study the following sections in the text and recommended references:

Electrical Wiring Practice: Pethebridge & Neeson 7th Edition

Volume 1 Chapter 5 Fixing Methods and Accessories for Electrical and Data/Communication Installations

Volume 1 Chapter 7 Accessories that form part of wiring systems

Standards Australia Wiring Rules AS/NZS 3000:2018

2. Read the Summary and practise answering the Work Sheets and the Review Questions provided in Electrical Wiring Practice: Pethebridge & Neeson 7th Edition. Refer to other relevant texts if you feel it is necessary.

3. Submit your answers to the Work Sheets to your Lecturer for discussion and feedback.

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Hollow walls

1. One of the jobs of an electrician is to mount cables, conduit and other devices like switchboards, socket outlets and lights to hollow walls. Because of this you need to develop an understanding of how to do so.

2. Hollow wall is typically a wall made up of wall supports enclosed by a thin layer of material, with the internal area forming a void.

3. Hollow walls come in many different materials and are often referred to or called by the material that they are made of. Some examples of this are shown below.

Figure 1 © Boral
Steel frame hollow wall with plasterboard

Figure 2 © Boral
Timber frame hollow wall with plasterboard

4. However hollow wall is not limited to the use of plaster board. There are many other types of hollow wall, including: Wood panelling and sheet
   Masonry blocks
   Pressed fibre cement cladding

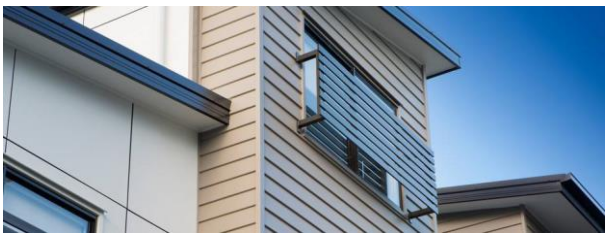

Figure 3 © James Hardie
External cladding (pressed fibre cement)

Figure 4 © Baines Masonry
Masonry blocks

5. Each of these methods of construction requires a unique method of fixing. Yet they all follow a similar technique, except for wood. The basic idea is to provide for a way of securing the device by spreading the load over a larger area on the void side of the hollow wall.

6. Wood can be fixed to by the use of nails, screws or adhesives. Nails and screws work because as they are driven into the wood they cause the wood to deform and hold the nail or screw via friction. Adhesives are simply some form of glue being used to stick to the wood.

7. Wood frame or steel frame walls offer the advantage that prior to the plaster board or panelling being installed, it is possible to install wall plates to fix power points and switches with. If larger items are to be secured it is often advisable to install trimmers (extra noggins).

8. Masonry blocks can be fixed to using the same methods as hollow wall but using drills and drill bits suited for masonry.

9. No matter what type of material being fastened to, care must be taken to ensure the right type of fixing is used. The following is a list of some of the factors that must be taken into account when selecting a fixing device:

   a. The need to comply with the manufacturers specifications (installed correctly).
   b. Environmental effects such as moisture, corrosive liquids or atmospheres, risk of vibration or mechanical damage.
   c. Support the weight to be exerted when it is in service
   d. The tools and fixings to be used.
   e. The type of material.
   f. Cost, ease of fitting, speed and appearance.
   g. Whether or not it is temporary or permanent.

10. It is important to note that all fixing devices are only as strong as the material they are anchored into. This means that whilst the fixing may have a load rating it is conditional on the material being sufficient to meet that load rating.

Nails

11. Whilst fixing to timber and masonry can be achieved by nailing; in practice nail-type fixing is limited in use, due mainly to its permanent nature. Any type of nail fixing in mortar joints should be avoided.

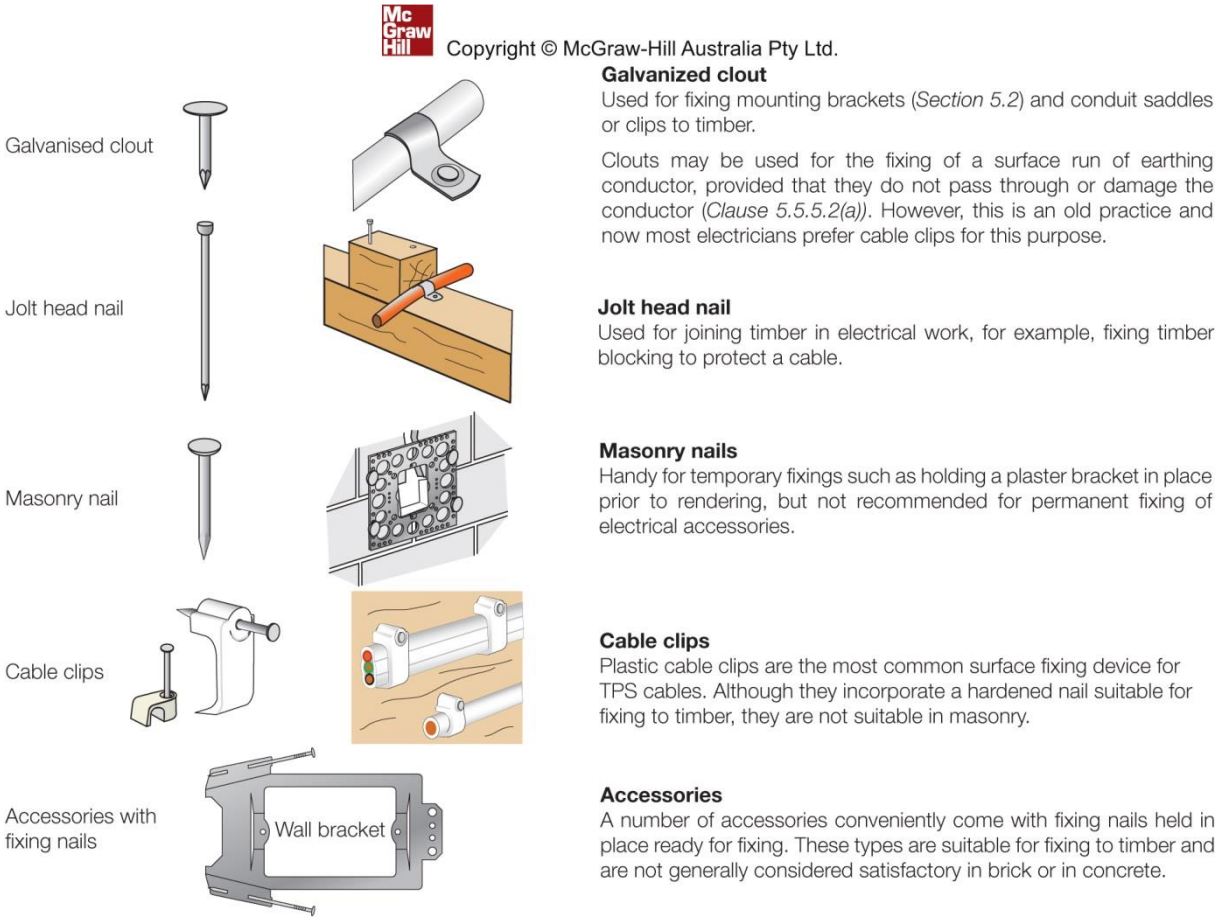

Figure 5 © McGraw-Hill
Common nails and their uses in the electrotechnology industry

12. Nails are identified by the type of head, the length of the nail and the material used to make them.

13. Nails are driven in by the use of a hammer or a nail gun that is either pneumatic or powder powered.

Screws

14. Unlike nails which are limited in their usage, screws are ubiquitous in their usage and are used in a variety of materials and even in other fixing devices.

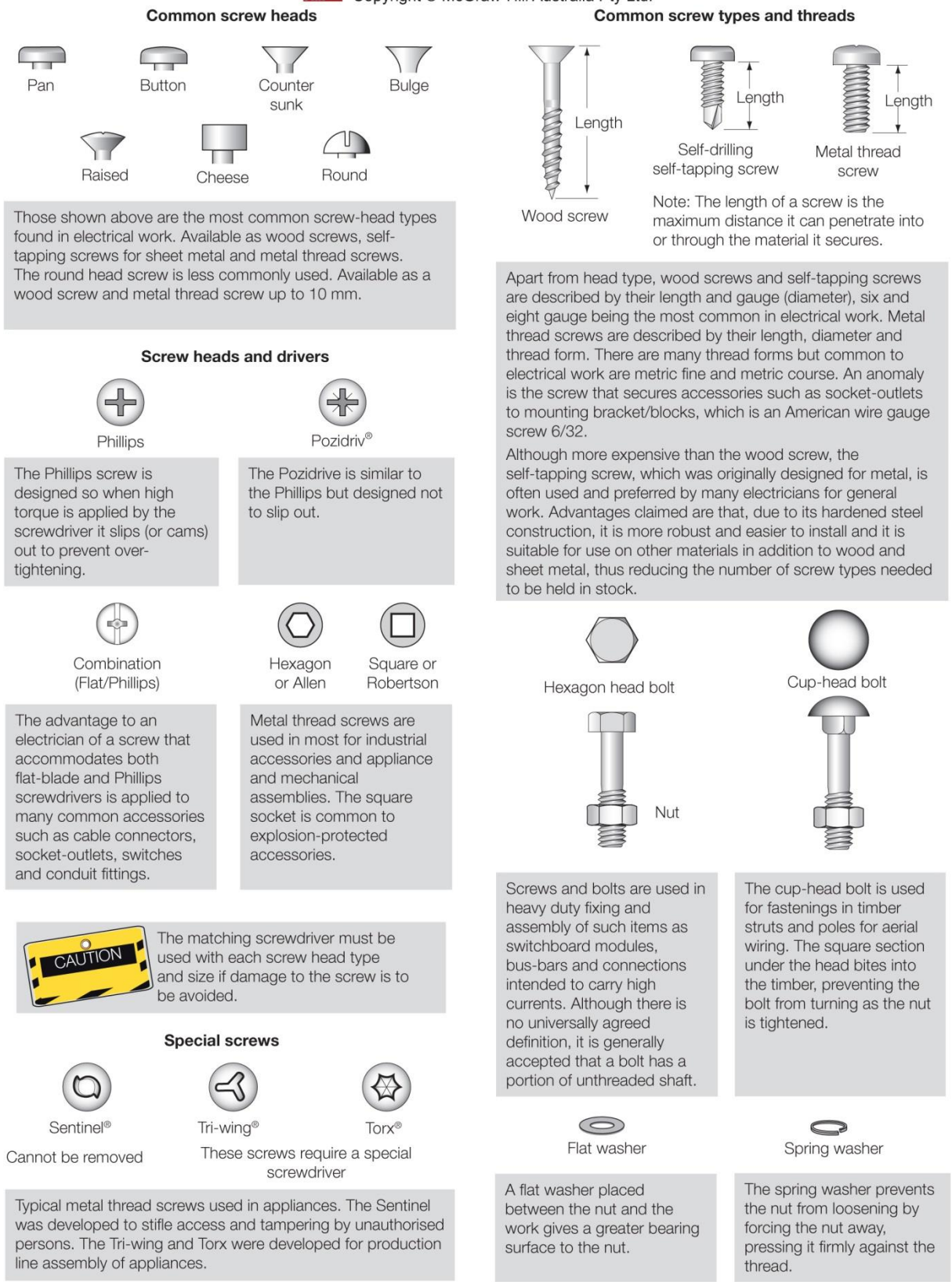

Figure 6 © McGraw-Hill
Screws

15. It is important to realise that screws are made for specific purposes and as such have certain characteristics and features that enable them to perform those tasks. For example a wood screw has coarser thread and is self-tapping albeit with a needle point rather than fluted. This is contrasted to a metal self-driller which has fine thread and a fluted tip.

Figure 7 © Bunnings Warehouse
Timber and metal screws

16. To help with selecting the right screw to use, a guide is shown below in Figure 8.

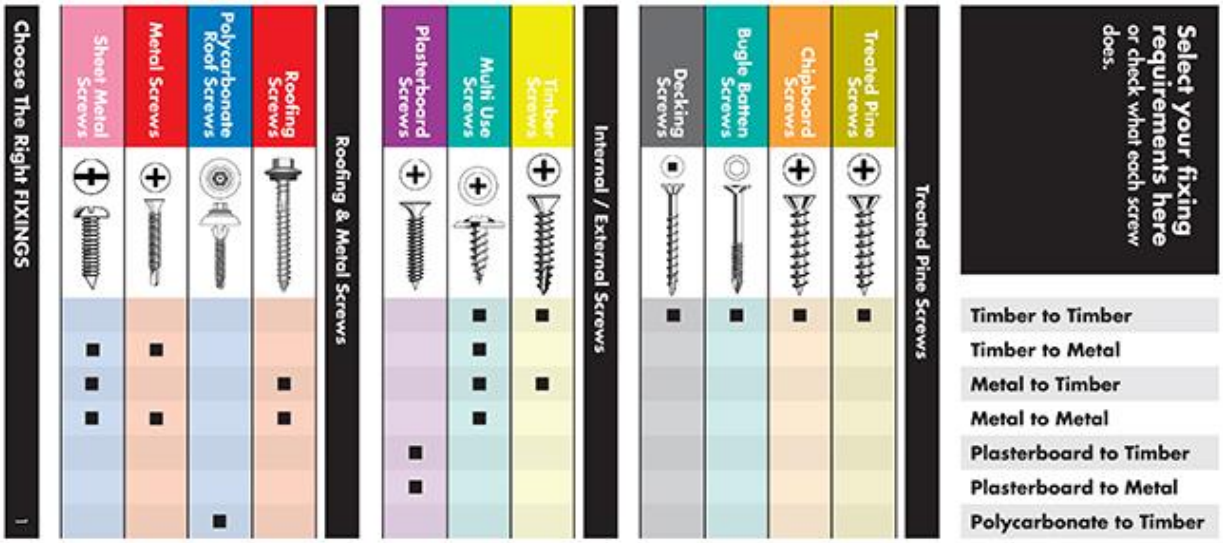

Figure 8 © Bunnings Warehouse
Screw Selection

17. To enable Electrotechnology workers to affix larger items like air-con brackets and TV antennas the electrician must use either bigger screws (limited in practice) or specialist screws. The most common of these specialist screws is a Coach Screw. This in reality is a large wood screw capable of large loads.

Figure 9 © Bunnings Warehouse
Coach Screw

18. Screws are typically driven in by a screwdriver that maybe a hand tool, electric or pneumatic. Screws may also be driven in by the use of sockets and wrenches or even Allen keys.

19. The following are some examples used in the electrical industry of fasteners that can be used for hollow wall applications.

HOLLOW WALL ANCHOR

20. The Ramset™ Hollow Wall Anchor is an all metal, light duty, cavity fixing for plasterboard and other hollow wall materials up to 38mm.

Figure 10 © Ramset
Hollow wall anchor

Installation

1. Drill a hole to the recommended diameter.
2. Tap the anchor into the hole until it is flush with the surface of the substrate.
3. Attach the setting tool to the head of the screw. Squeeze the trigger to expand the anchor. (Small sizes may be set using a screwdriver)
4. Remove the screw and place it through the fixture then back into the anchor. Tighten the screw until the fixture is fixed.

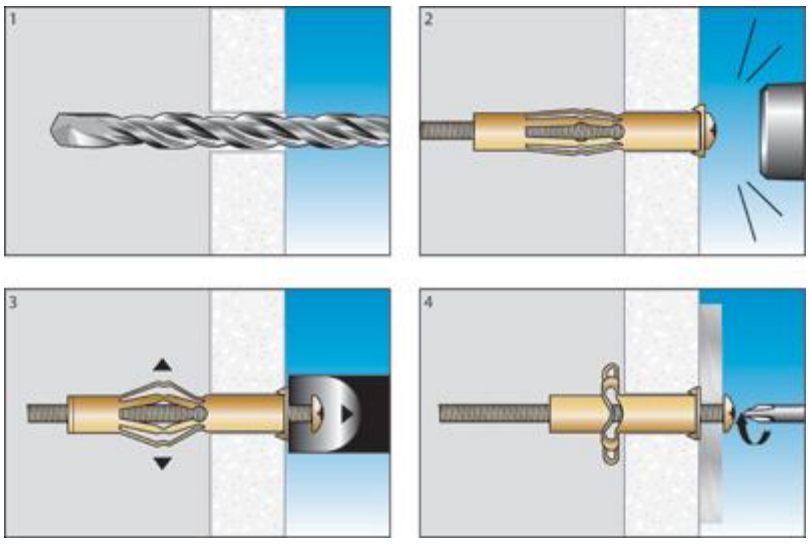

Figure 11 © Ramset
Hollow wall anchor installation

21. The tool used to expand the anchor is called an anchor tool or setting tool and looks like this;

Figure 12 © Ramset
Hollow wall anchor set tool

Features & Benefits

22. The Hollow Wall Anchor's low profile head allows for flush finishing.

The anchor's large flange prevents the head from pulling into the substrate.

Anti-rotation barbs, incorporated in the flange, prevent the anchor from spinning in the hole.

Collapsing legs with an integral nut provide high strength and allow the screw to be removed without losing the anchor inside the cavity.

Uses

23. Light hook, bracket, electrical fittings and conduit saddle installation. The maximum load is only 10kg for 12mm plasterboard walls.

WALLMATE

24. The WallMate™ is the original self-drilling plasterboard anchor. Available in nylon or zinc, the WallMate™ would probably be the quickest and easiest plasterboard anchor to install and remove.

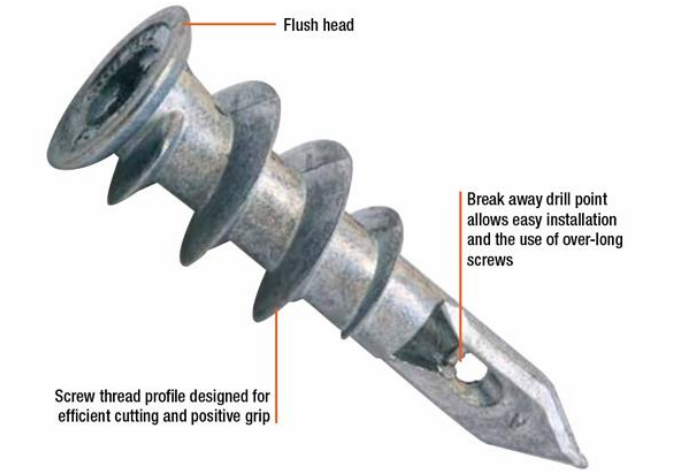

Figure 13 © Ramset
WallMate

Features & Benefits

25. Both versions of the WallMate™ feature an effective drill point for easy penetration of plasterboard and fast installation. If a long screw is used, this point will break away so as not to restrict achievement of a firm fix.

    The anchor's screw thread profile is designed for efficient cutting and positive grip.

    Both the screw and the WallMate™ can be easily removed without losing the anchor inside the cavity.

    The low profile head allows for flush fixing.

Installation

1. Insert the point of a #2 Philips Head screwdriver into the recess of the WallMate™, place the drill point against the wall, lightly piercing the face paper, and screw the anchor into the plasterboard until the head is flush with the surface.
2. Place the fixture over the anchor, insert the appropriate gauge screw through the fixture, into the head of the WallMate™ and tighten the fixture in place.

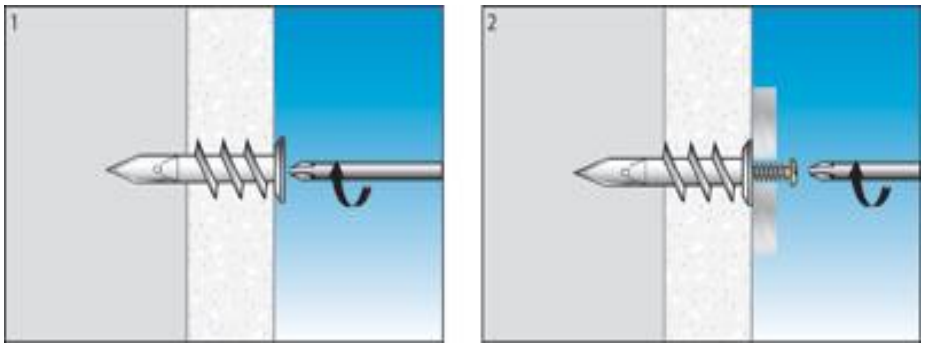

Figure 14 © Ramset
WallMate installation

Uses

26. Light Hook and electrical fitting installation. Only suitable for light loads.

TOGGLEMATE

27. The ToggleMate™ is a self-drilling toggle anchor for heavy duty, vibration resistant fixing in plasterboard.

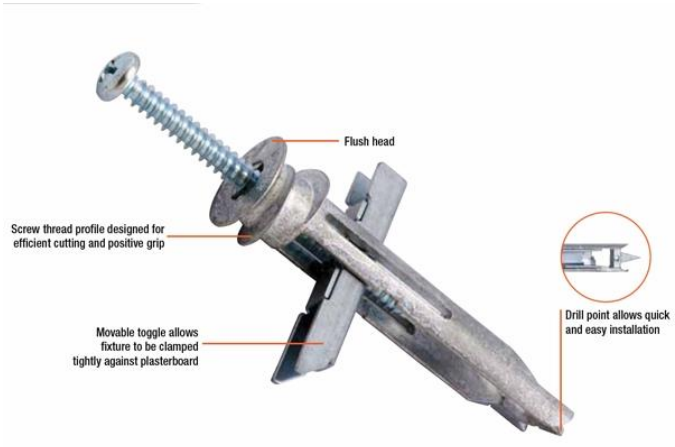

Figure 15 © Ramset
ToggleMate

Features & Benefits

28. The ToggleMate™ features an effective drill point for easy penetration of plasterboard and fast installation.

    The anchor's screw thread profile is designed for efficient cutting and positive grip, while the movable toggle allows the anchor to clamp the plasterboard for added strength.

Both the screw and the ToggleMate™ can be easily removed without losing the anchor inside the cavity.

The low profile head allows for flush fixing.

Installation

1. Insert the point of a #2 Philips Head screwdriver into the recess of the ToggleMate™, place the drill point against the wall, lightly piercing the face paper, and screw the anchor into the plasterboard until the head is flush with the surface.
2. Place the fixture over the anchor, insert the 8 gauge screw through the fixture, into the head of the ToggleMate™ and turn to engage the clamp. Continue to turn the screw until the clamp is pulled tight against the plasterboard

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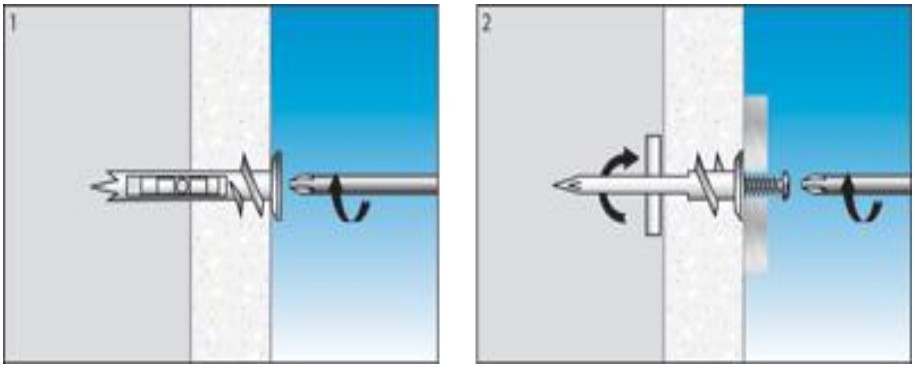

Figure 16 © Ramset
ToggleMate installation

SPRING TOGGLES

29. Ramset™ Spring Toggles are all metal wing cavity anchors, ideal for both wall and ceiling applications.

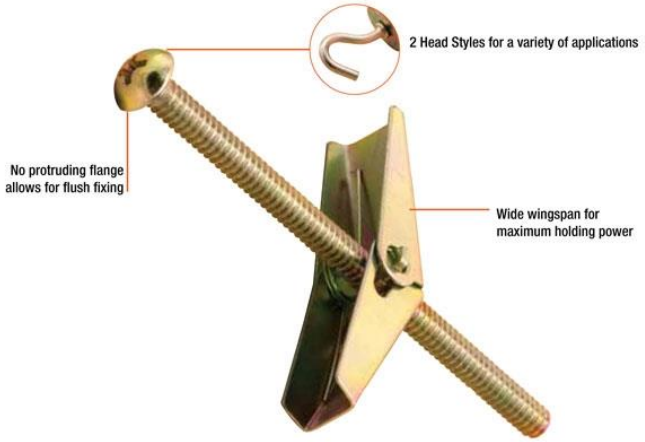

Figure 17 © Ramset
Spring Toggle

Features & Benefits

30. Ramset™ Spring Toggles have a wide wingspan to give high loadings in both plasterboard wall and ceiling applications.

No protruding flanges allow for ultra-flush fixing (Countersunk and Round head only).

Low profile round or countersunk screw heads suit various fixture recesses. Handy hook profile also available

Installation

1. Drill the recommended sized hole through the plasterboard.
2. Pass the screw through the fixture and into the toggle for a few turns. Compress the toggle wings and insert the anchor into the hole. The wings will spread behind the cavity wall.
3. Pull back on the fixture to hold the toggle in place against the reverse side of the cavity wall and tighten with a screwdriver, pulling the wings of the anchor firm against the cavity wall.

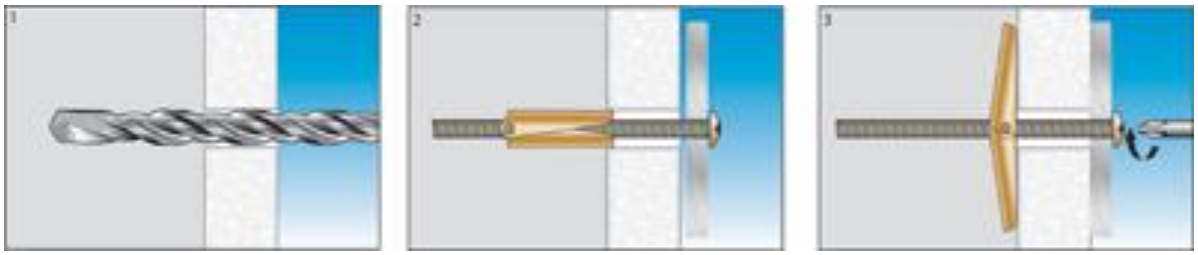

Figure 18 © Ramset
Spring Toggle Installation

RAM TOGGLE

31. The RamToggle™ is a one piece, light duty nylon cavity fastener.

Figure 19 © Ramset
Ram Toggle

Features & Benefits

32. The RamToggle™ features a wide wingspan for maximum holding power

Anti-rotation fins prevent spinning in the hole when installing the screw.

The low-profile head allows for flush fixing.

The nylon body is non-conductive

Installation

1. Drill an 8mm hole through the plasterboard.
2. Compress the wings of the RamToggle™ and insert the anchor into the hole. If necessary, tap with a hammer to ensure a flush fit with the surface.
3. The wings will spread behind the cavity wall.
4. Insert the appropriate gauge screw through the fixture, into the RamToggle™ and tighten, pulling the wings of the anchor firm against the cavity wall.

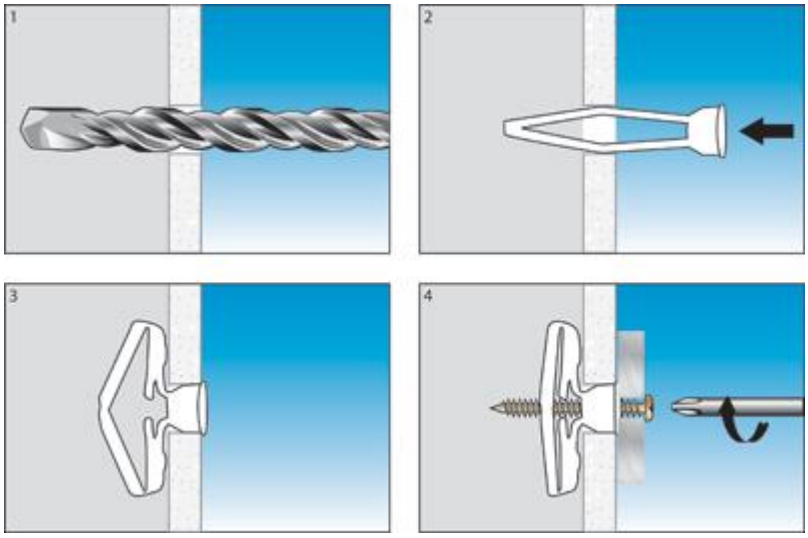

Figure 19 © Ramset
Ram Toggle

33. They are suited to light loads only.

Fixing to hollow masonry block. **NOTE – *See section 2 of this book for information on drilling masonry and using chemical fixings.*

34. Secure fixing to hollow masonry can be achieved by using a chemical compound such as Ramset “ChemSet 101” or “Ultrafix” along with a nylon sleeve to assist to contain and form the adhesive into a shape and size that will cure and provide a secure base for fixing.

Figure 20 © Ramset
ChemSet 101 and nylon sleeve

35. These fixings are suitable for medium duty loads.

36. The following link can be used to view fixing demonstrations.

http://www.ramset.com.au/Document/Detail/265/Ramset-AnkaScrew-Rod

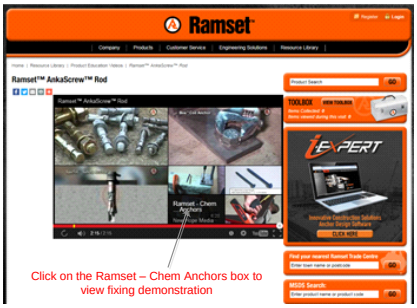

Figure 21 © Ramset
ChemSet Demonstration Video

Hollow Wall Questions

		T No.
1.	Name TWO advantages of the following fixing devices a. Hollow Wall Mate b. Wallmate c. Togglemate d. Spring Toggle e. Ram Toggle	1.1/1.3 1.5
2.	Give an example where the following nails would be used in electrical work: a. masonry nail b. clout c. jolt head nail.	1.3
3.	What is the difference between Phillips and Pozidrive screws?	1.3
4.	Why is it important to match a screwdriver with the screw head type and size?	1.1
5.	What determines the length of a screw or bolt?	1.3
6.	Name 4 fastening devices used to fix accessories to a hollow plasterboard wall.	1.1/1.5
7.	What fastening device would you use to fix TPS cable to a stud wall?	1.3/1.5
8.	What type of washer prevents a nut and bolt from coming loose?	1.3
9.	Name 3 types of fixing devices you would use to fasten a mounting plate to a stud or noggin?	1.1 1.3
10.	Name the device used to compress the hollow wall anchor before fixing an electrical accessory?	1.4/1.5
11.	What type of bolt would you use for fastening a riser bracket for an aerial cable to the wood frame of a house?	1.3
12.	What type of drill bit would you use to create a 12mm hole in hollow wall board?	1.2/1.4
13.	What type of device would you use to create a 80mm hole in hollow wall board?	1.2/1.4
14.	What type of drilling machine would you use to create an 8mm hole in hollow masonry block?	1.4
15.	What type of device would you use to create a 300mm hole in hollow wall board?	1.2/1.4
16.	What tool would you use to drive a Wallmate anchor into hollow wall board?	1.2/1.4
17.	What product would be suitable for mounting a light switch on a hollow wall board?	1.1/1.3
18.	What type of fixing would be suitable to fix a television bracket to a stud wall?	1.1/1.5
19.	What type of fixing would be suitable to fix a 40kg tool cabinet to a hollow masonry wall?	1.1/1.5
20.	What document should you read carefully before using any chemical fixings?	1.1/1.3
21.	What PPE is required when drilling and cutting hollow wall board?	1.1/1.3

Q No.	Answer
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Hollow Wall Practical

Task:

To affix two power points, two switch plates, and one batten holder to a piece of plasterboard using five differing methods.

SAFE WORK PRACTISES MUST BE FOLLOWED

PPE MUST BE WORN

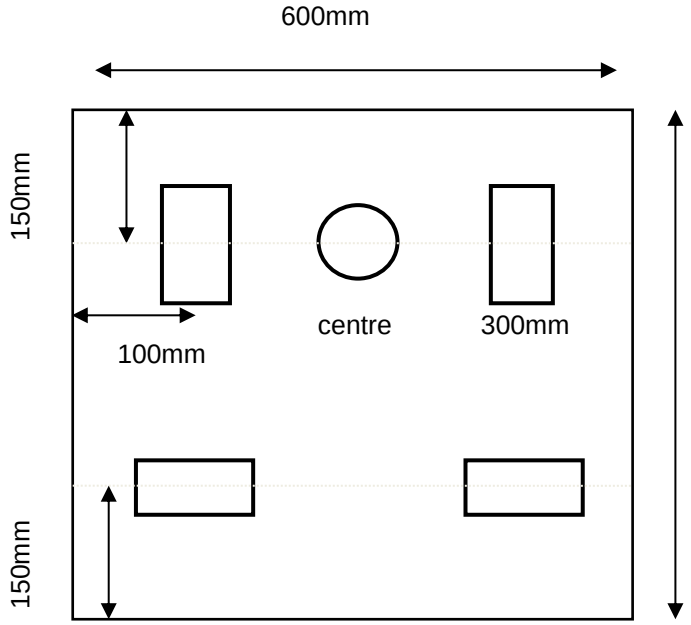
Aids Permitted:

Tool box and plasterboard fixings
2 x 2031VA switch plates
2 x 2015 socket outlets
1 x 530 batten holder
1 x piece of plasterboard 600mm x 600mm

Method:

Fix switches, batten holder, and power points according to the following diagram (note: switches are vertical and power points horizontal with the circle indicating the batten holder). Making sure to use each of the following devices:

Clipsal wall anchors
C clip
Hollow wall anchor and tool
WallMate
Ampere nylon anchor



Feedback and Recommendations:

Student's Signature: _____ **Date:** _____

Assessor's Signature: _____ **Date:** _____

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Solid Wall

1. One of the jobs of an electrician is to mount cables, conduit and other devices like switchboards, socket outlets and lights to solid walls. Because of this you need to develop an understanding of how to do so.

2. Solid wall is typically a wall made up of masonry, which is sometimes covered by a thin layer of material like plaster or render.

3. Masonry is construction using some form of mortar to bind different materials. These materials include but are not limited to bricks, stones, marbles, granites, concrete blocks, tiles etc.

Figure 20 © Pixabay
Stone Wall

Figure 21 © By z22 - Own work, CC BY-SA 3.0,
Brick Wall

4. Each of these methods of construction requires a unique method of fixing and special care. Yet they all follow a similar technique. The basic idea is to provide for a way of securing the device by gripping via friction or chemicals the side of a hole drilled or cut into the material.

5. Drilling and cutting into masonry requires specialised cutting edges, tools, and safety equipment. For drilling masonry, a bit is required to have a chisel point on the top of a twist bit and to use a drill capable of hammer action. An example of the drill bit is shown below. The SDS drill bit shown below has the advantage of not requiring chuck to be rotated to change the bit. Simply pull back the spring loaded sleeve around the chuck to release the bit.

Figure 22 © Bunnings Warehouse
SDS Masonry Drill Bit

6. Cutting into masonry to perform chases or the like requires a diamond tipped blade or wheel or a material wheel that is marked for masonry. These come in different types for different materials see below.

Figure 23 © Bunnings Warehouse
Diamond Blades

7. The hard glazed materials like ceramic tiles and glass require separate specialised drill bits, an example of which is shown below.

Figure 24 © Bunnings Warehouse
Glass & Tile Drill Bit

8. Once a hole has been created, it then becomes a choice on either using an expansion type anchor that uses friction to hold in or a chemical type of fixing that glues the device in place. They both have positives and negatives that must be considered when selecting a method to use.

9. No matter what type of material being fastened to, care must be taken to ensure the right type of fixing is used. The following is a list of some of the factors that must be taken into account when selecting a fixing device:

    a. The need to comply with the manufacturers specifications (installed correctly).
    b. Environmental effects such as moisture, corrosive liquids or atmospheres, risk of vibration or mechanical damage.
    c. Support the weight to be exerted when it is in service
    d. The tools and fixings to be used.
    e. The type of material.
    f. Cost, ease of fitting, speed and appearance.
    g. Whether or not it is temporary or permanent.

10. It is important to note that all fixing devices are only as strong as the material they are anchored into. This means that whilst the fixing may have a load rating it is conditional on the material being sufficient to meet that load rating.

Nails

11. Whilst fixing to masonry can be achieved by nailing; in practice nail-type fixing is limited in use, due mainly to its permanent nature. Any type of nail fixing in mortar joints should be avoided. Nails are most often used in concrete as opposed to the harder and brittle materials like stone, brick and ceramic.

12. Nails are identified by the type of head, the length of the nail and the material used to make them.

13. Nails are driven in by the use of a hammer or a nail gun that is either pneumatic or powder powered and eye protection must be worn.

Figure 25 © Ramset
Masonry Nails

Screws

14. Unlike nails which are limited in their usage due to their permeant nature, screws are able to be reused and offer the option of easy removal.

15. As mentioned earlier it is important to realise that screws are made for specific purposes and as such have certain characteristics and features that enable them to perform those tasks. An example of a masonry screw is shown below. Please note the lack of self drilling.

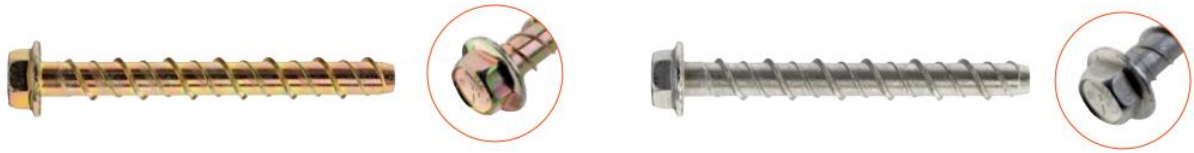


Figure 26 © Ramset
Masonry Screws

Expansion Anchors

16. Where screws are the predomiante form of fixings for hollow wall, expansion anchors are for solid wall.

17. They work by cutting/drilling a hole into the material and then placing a fixing device into the hole. Once in the hole the fastening is then manipulated by doing up a screw or driving in a nail so as to cause the fastener to expand and grip the material.

18. Due to the expansion action these devices cannot be used near the edge of a surface as it will break off.

19. Examples of expansion anchors include plastic wall plugs, tap ins (ShureDrive anchor) and dynabolts as shown below.

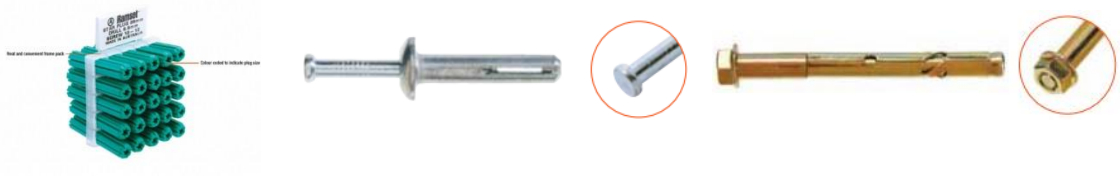


Figure 27 © Ramset
Expansion Anchors

20. The following are some examples used in the electrical industry of fasteners that can be used for solid wall applications.

PLASTIC PLUG

21. Ramset™ plastic plugs are inexpensive, traditional expansion plugs for light duty anchoring in concrete, stone, solid brick and solid block and may be used with screws.

Figure 28 © Ramset
Plastic Plug

Features & Benefits

22. Comes in different sizes and are colour coded for easy recognition.

Red	6mm
Green	6.5mm
Blue	8mm

Installation Guide

1. Drill a hole to the appropriate diameter and depth. Remove the debris with a hand pump, compressed air, or vacuum.
2. Insert the plug into the hole.
3. Screw the screw through the fixture into the plug until fixture is firm against the substrate.

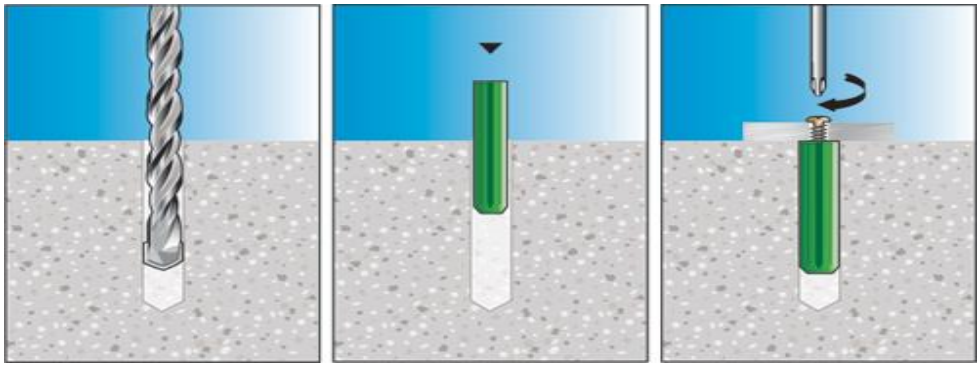


Figure 29 © Ramset
Plastic Plug Installation

23. They are suited to light loads only.

NYLON ANCHOR

24. The Ramset™ Nylon Anchor is a removable light duty, impact/rotation setting, interference fit anchor, with a variety of head styles, designed for use in a variety of substrates such as concrete, stone, solid brick, solid block, grout filled block and hollow block.

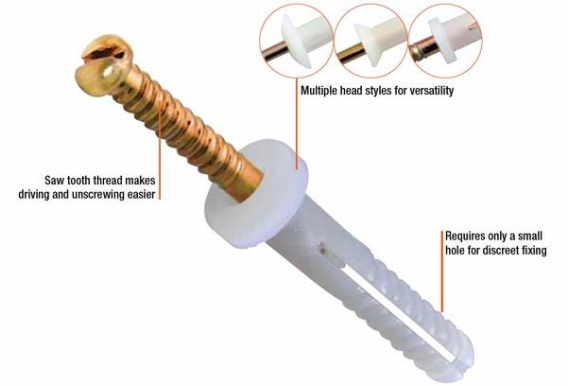


Figure 30 © Ramset
Nylon Anchor

Features & Benefits

25. Available in multiple head styles for versatility.

The drive screw's saw tooth thread makes it easy to drive and unscrew.

Requires only small diameter holes for discreet fixing.

Nylon body provides insulation between drive screw and work surface.

Installation Guide

1. Drill a hole to the recommended diameter and depth using the fixture as a template. If the fixture thickness is less than the maximum, increase the hole depth accordingly. Remove the debris with a hand pump, compressed air, or vacuum.
2. Insert the anchor through the fixture until the collar of the anchor contacts the fixture.
3. Screw or hammer home the drive screw until the head is flush with the collar of the anchor. The drive screw can easily be removed with a screwdriver

Figure 31 © Ramset
Nylon Anchor Installation

27. They are suited to light loads only.

NYLON FRAME ANCHOR

28. The RamPlug™ Nylon Frame Anchor is a light duty, rotation setting, interference fit anchor, designed for use in a variety of substrates such as concrete, stone, solid brick, hollow brick, solid block, hollow block, hollow slab block and lightweight concrete (AAC) block. Available in Standard, Long and Ultra Long, with (Ultra Long only) or without a countersunk or hex head screw, there is a RamPlug™ for a range of light duty anchoring applications.

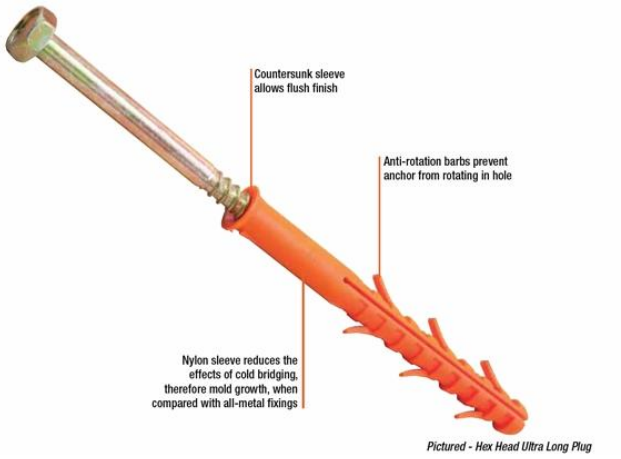


Figure 32 © Ramset
Nylon RamPlug

Features & Benefits

29. Anti-rotation barbs prevent the anchor from rotating in the hole.

    Countersunk sleeve allows for flush finishing.

    Nylon sleeve reduces the effects of cold bridging. e.g. mould growth, when compared to all-metal anchors

Installation Guide

1. Drill a hole to the recommended diameter and depth using the fixture as a template. If the fixture thickness is less than the maximum, increase the hole depth accordingly.
2. Clean the hole thoroughly with a hole cleaning brush.

3. Remove the debris with a hand pump, compressed air, or vacuum.
Insert the anchor through the fixture and tap with a hammer until the collar of the anchor contacts the fixture.
Tighten screw until the head of the screw is flush with the collar of the anchor

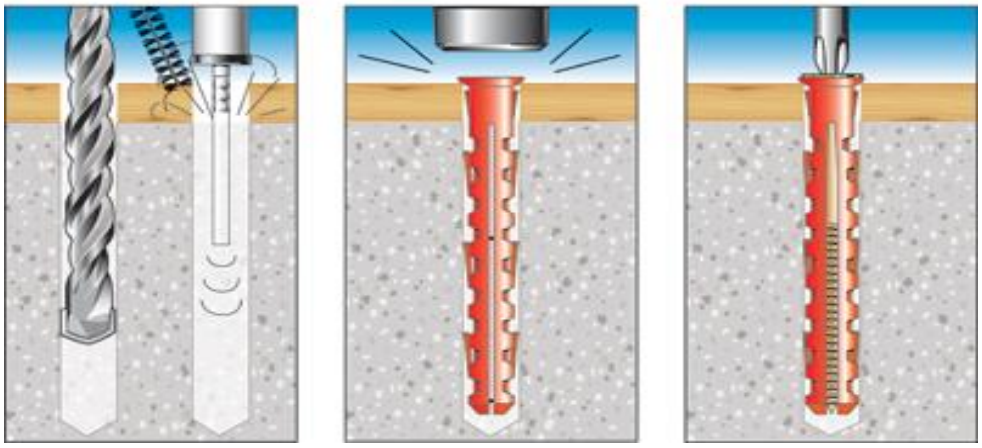


Figure 33 © Ramset
Nylon RamPlug Installation

31. They are suited to light loads only.

DYNABOLT

32. The DynaBolt™ Plus Sleeve Anchor is a medium duty, torque controlled, expansion anchor, with an integrated pull-down section, designed for medium duty anchoring of timber and steel fixtures to concrete, brick or block. The DynaBolt™ Plus is available in a variety of different head styles and finishes

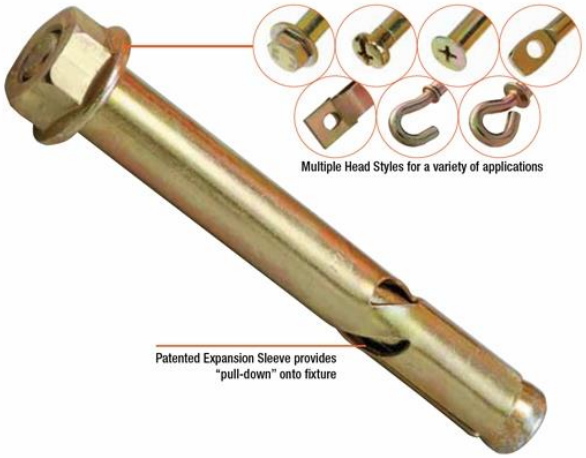


Figure 33 © Ramset
DynaBolt

Features & Benefits

33. The DynaBolt™ Plus patented expansion sleeve closes gaps of up to 5mm, pulling down on the fixture to induce clamp load and provide improved security.

The DynaBolt™ Plus is a fully assembled through fixture anchor. Therefore, assembly, marking out and re-positioning of fixtures is eliminated making installation fast and easy.

The choice of multiple head styles makes the DynaBolt™ Plus a versatile anchor for a variety of different applications.

Installation Guide

1. Drill or core a hole to the recommended diameter and depth using the fixture as a template. Clean the hole thoroughly with a hole cleaning brush. Remove the debris with a hand pump, compressed air, or vacuum.
2. Insert the DynaBolt™ Plus through the fixture and drive with a hammer until the washer contacts the fixture.

3. Tighten the DynaBolt™ Plus, allowing the sleeve to twist and pull down the fixture firmly onto the substrate. For optimum performance, a torque wrench should be used.

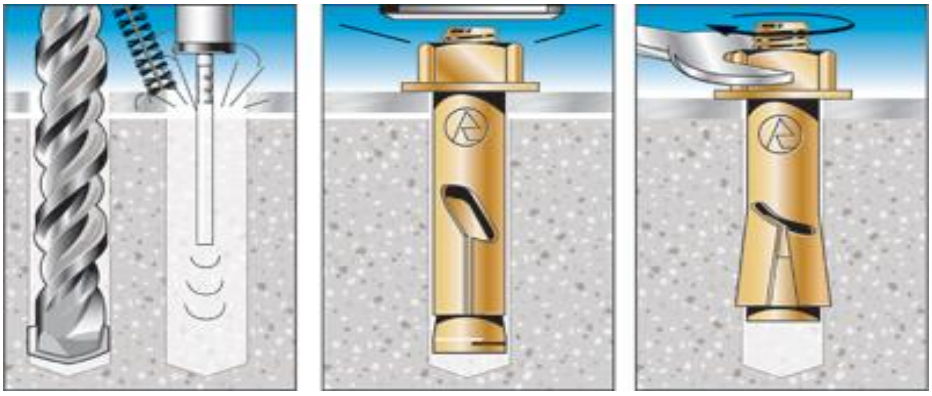


Figure 33 © Ramset
DynaBolt Installation

35. They are suited for up to medium duty loads.

36. A disadvantage of a Dynabolt is if the item is removed the bolts are left protruding.

LOXIN

37. The Loxin™ Shield Anchor is a medium duty, torque controlled, internally threaded, expansion anchor, designed for use in solid substrates such as concrete, brick, block and stone. The Loxin™ requires the installation of a machine bolt or threaded rod to set.

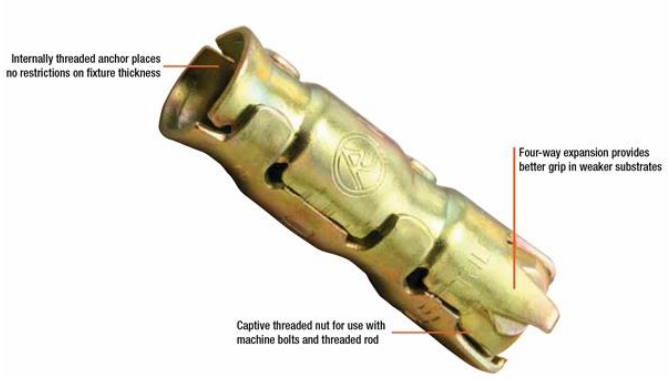


Figure 34 © Ramset
Loxin

Features & Benefits

38. The Loxin™ fits flush with the surface of the substrate, leaving no protrusions when not in use.

The anchor's internal thread facilitates the use of machine bolts and threaded studs of any length removing restrictions on fixture thickness.

The Loxin™ requires only shallow embedment, which reduces the risk of striking rebar during hole drilling.

Four-way expansion provides better grip in weaker substrates.

When the Loxin is removed there are no bolts protruding.

Installation Guide

1. Drill or core a hole to the recommended diameter and depth. Clean the hole thoroughly with a hole cleaning brush. Remove the debris with a hand pump, compressed air, or vacuum.
2. Insert the Loxin™ into the hole, nut end first, and tap with a hammer until it sits flush with the surface of the substrate.

3. Position the fixture over the Loxin™, insert the correct diameter bolt or stud through the fixture and tighten

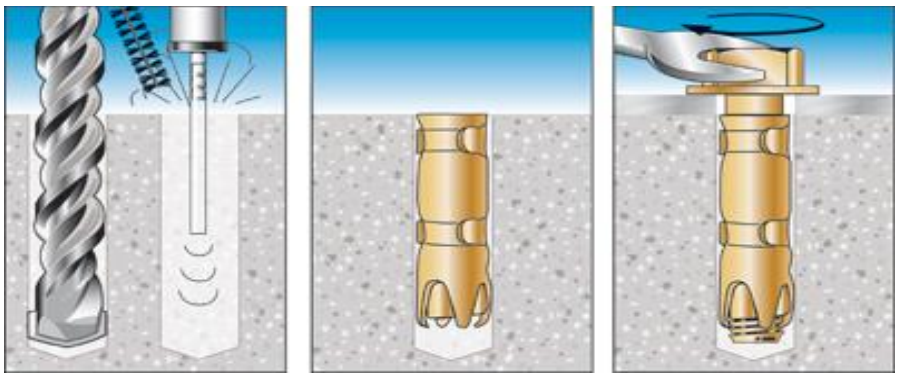


Figure 35 © Ramset
Loxin Installation

40. They are suited for up to medium duty loads.

SPATEC PLUS

41. The SpaTec™ Plus Safety Anchor is a heavy duty, torque controlled expansion anchor, with an integrated pull-down section, designed for high performance in both static and dynamic load applications, in both cracked and non-cracked concrete~ . The SpaTec™ Plus is ideally suited for through fixing into concrete when security and reliability are paramount.

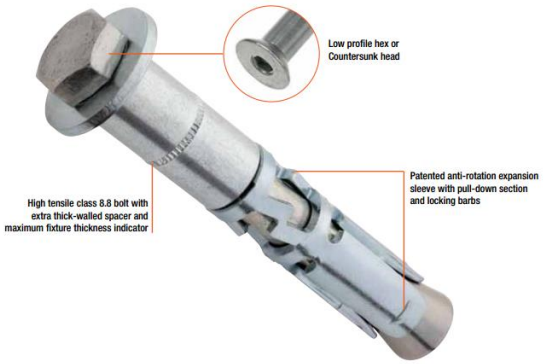


Figure 36 © Ramset
SpaTech

Features & Benefits

42. The combination of a high tensile class 8.8 bolt with an extra thick-walled spacer allows a smaller diameter bolt to be used for easier installation while still providing both excellent tensile and shear performance. The spacer also incorporates a visual maximum fixture thickness indicator for ease of use.

    The patented anti-rotation expansion sleeve is designed with sharp angled protrusions that grip the sides of the hole, preventing anchor rotation during installation. As expansion of the sleeve begins, the locking barbs also grip the sides of the hole, further embedding as expansion progresses, giving extra holding power. The sleeve pulls down during tightening ensuring excellent pressure between the fixture and the concrete.

    The low profile hex or countersunk heads provide a neat finish.

Installation Guide

1. Drill or core a hole to the recommended diameter and depth using the fixture as a template. Clean the hole thoroughly with a hole cleaning brush. Remove the debris with a hand pump, compressed air, or vacuum.
2. After ensuring that the anchor is assembled correctly, insert the anchor through the fixture and drive with a hammer until the washer contacts the fixture.
3. Tighten the bolt with a torque wrench to the specified assembly torque.

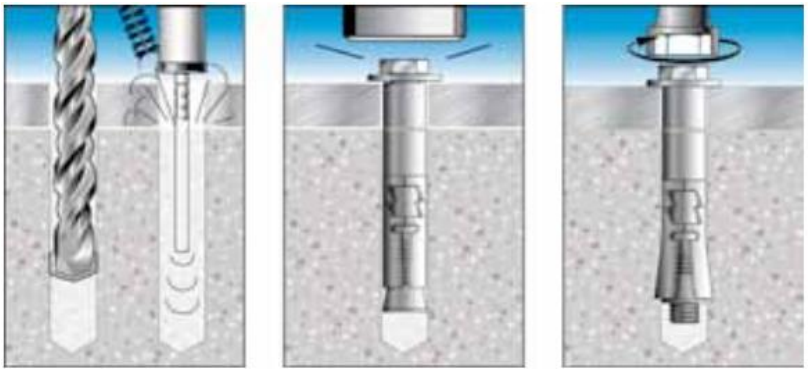


Figure 37 © Ramset
SpaTech Installation

43. Suited for heavy duty applications.

POWDER/GAS FIXING METHODS

44. A highly productive method of installing fixings is the use of percussion tools operated by powder, also known as an explosive charge, or by compressed gas.

45. This method uses a special tool with a piston driven by a powder charge or compressed gas which in turn drives a special type of nail, screw or stud into brick, concrete or even solid steel such as a structural steel beam.

46. These fastening tools are commonly referred to in the trade as ‘guns’. They however cannot be used as guns because of certain built-in safety features.

47. It is particularly efficient where multiple fixings are required, such as for cable supports in concrete above suspended ceilings and runs of conduit, cable tray and cable ladder.

Explosive charges

48. These explosive charges provide the driving force to penetrate into the work surface. The fastener requires different forces to penetrate concrete, steel or brick and for the required depth. Different power ratings are made. These explosive charges are very similar in appearance to a blank cartridge for a rifle. To enable the operator to determine the different power ratings of each charge, they are colour coded.

.

Safety

49. These tools use an explosive charge to drive the fastener into the work surface therefore extreme safety precautions must be taken when operating one.

50. Operators intending to use powder-actuated tools should be adequately trained in every aspect of their use. A certificate of competency for the operator of a powder- activated tool is required in most jurisdictions. This most often is obtained as part of doing the manufactures training. According to AS 1873.1.2003 (Clause 1.4.3) the definition of a competent person is as follows.
    1.4.3 Competent person
    A person who has acquired through training, qualification, or experience, or a combination of these, the knowledge and skills enabling that person to perform the task required.
    NOTE: Persons using PA tools who exhibit colour blindness need to be able to demonstrate they are capable to identify different charges.

51. These powder-actuated tools have special safety features built into them which include:
    1. It will not fire if it is dropped.
    2. The tool must be pressed against a solid and reasonably level surface with a pressure that will overcome the spring-loaded tip before it is fully cocked.
    3. The tools are fitted with an approved safety shield, around the barrel.
    4. The tool will not cock or fire if the safety shield has been removed.

52. Indirect-acting tools contain all the built-in safety features of the direct-acting tools, with the exception of the safety shield.

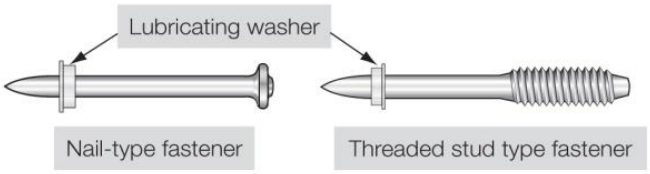
Powder and gas fastening systems

This powder actuated tool is typical of the type used for fixing wiring accessories in concrete and steel. The cartridges are suppied as mounted on a plastic strip which fits in the top of the tool acting as a magazine.

The gas actuated tool shown uses pressure from a gas cartridge to drive a fastener in a similar way to the powder actuated tool. Fasteners are supplied as mounted in a plastic strip for insertion in the magazine which increases the efficiency of continuous fastening operations.

The driving power of powder cartridges is shown by a colour code from green (the lowest), through yellow and red to black (the highest). The power needed will depend on the base material and the type of fastener to be used.

The fasteners shown below are only a sample of fasteners available for use with powder actuated tools. Specifics and application of the many other types are provided in manufacturers' catalogues and technical publications.



It is important to follow the manufacturers' guidance and recommendation when selecting the power of the charge and the type of fastener to use.

Powder and gas fastening accessories


Application by a gas actuated tool


Cable tie fastener


Conduit saddle


Cable clamp

Conduit clip


Cable clamp supporting conduits in a concrete slab above a suspended ceiling

Catenary clip

Handling

53. The tool should be transported in a case especially designed for it. Take care when removing or carrying the tool. Do not drop it or experiment with it.

Follow manufacturers' instructions

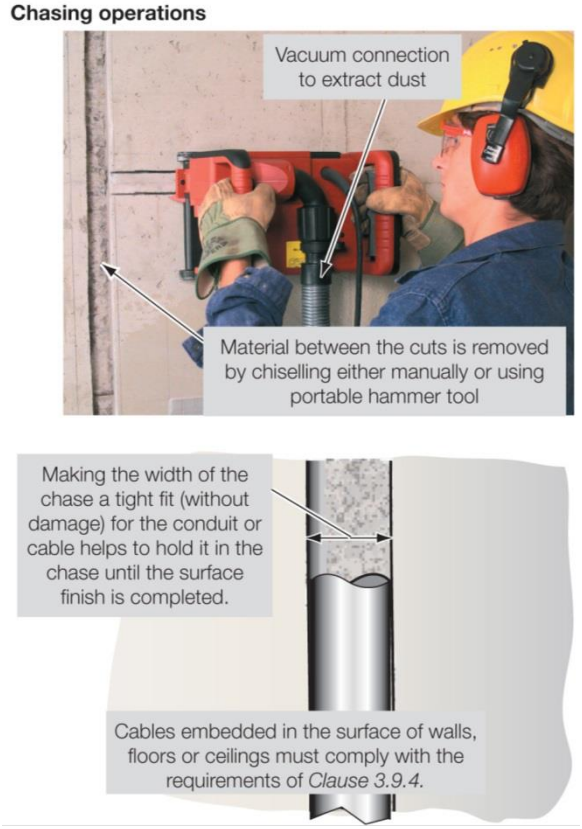
54. When selecting and installing fixings and fasteners, the manufacturers' guides and instructions must be followed. (See AS/NZS 3000 Wiring Rules Clause 1.7.2(b).)

CHASING

55. When working with a masonry wall that is to be rendered with cement and plaster or covered by timber lining or plasterboard, it is often preferable to install conduits and wall boxes into the wall before it gets lined or rendered and the surface finish applied.

56. This is done by cutting channels or grooves into the masonry which then get rendered over later. This is called chasing.

57. A common method for chasing masonry and concrete is to use a chasing machine fitted with two masonry-cutting bits. The distance the blades are set apart and their depth is adjustable and defines the width and depth of the 'chase'. The material between the two cuts is then chiselled out to complete the chase and an example is shown below.



58. Other tools that can be used to chase include wet-saws, 9inch and 4inch grinders. When chiselling out, tools that are used are often used are: hammer drill set to hammer only, hammer and chisel, and pneumatic chisels.

59. There are limits to the depth, length and direction in which a chase may be cut. Chases should be planned with the approval of the builder; otherwise, they could reduce structural integrity of a wall and the fire resistance levels (FLR) and acoustic performance rating (APR) for which the building structure is designed. The FLR and APR are set by the performance-based national building codes for different building types; that is, the Building Code of Australia (BCA).

60. It should go without saying that extreme care and attention must be given to the task when chasing so as to minimise the likelihood of injury; along with using the appropriate PPE and using it correctly.

61. The two most common items that may be used when chasing are:

Figure 38 © Clipsal
Wallbox

Figure 39 © Rexel
Conduit

CHEMICAL

62. These methods are normally used for heavy duty fixings and where the expansion of normal fixings could crack the concrete. They work by using chemical glue usually a two part resin that is either injected in via a chalking gun or by the use of glass phials that bonds to the material being fastened to.

63. These are rarely used due to their high cost and labour required. They are however the best option for heavy duty tasks where cost is not an issue and where circumstance require them i.e. the edge of a masonry wall or floor.

64. The product Materials Safety Data Sheet should be consulted prior to commencement of work to ensure the user if familiar with any OH&S or environmental issues associated with the use of these products.

65. Some examples of the chemical method fasteners are shown below.

Figure 40 © Ramset

Threaded Studs (ChemSet™ Anchor), Injection Mixer (ChemSet™ 101 Plus), Glass Phial (ChemSet™ Maxima™)

Solid Wall Questions

		T No.
1.	Name TWO of the advantages of the following fixing devices; (a) Plastic Plug (b) Nylon Anchor (c) Nylon Frame Anchor (d) Dyna Bolt (e) Loxin	2.1/2.2/2.3 2.6
2.	What are the colours and sizes for the plastic plugs used to secure electrical accessories?	2.3
3.	How would you secure the following items? (a) a mounting block on a masonry wall (b) a conduit saddle to a masonry wall (c) a floor-mounted switchboard to a concrete floor.	2.1/2.2/2.3 2.6
4.	How is a masonry drill different from a standard twist drill?	2.5
5.	Explain the principle of powder and gas fastening systems typically used in electrical work.	2.5/2.6
6.	List three items of PPE used with powder or gas fastening.	2.1/2.3
7.	For high-volume, fast fixing to masonry, the best system to use is: (a) loxins (b) gas fastening (c) drill and tap (d) dynabolts	2.1/2.2/2.3 2.6
8.	What certificate do you need to obtain before working with an explosive powered tool?	2.4
9.	Select a suitable fixing device to mount a switch board that weighs 50kg onto a solid brick wall.	2.1/2.3/2.6
10.	List three items of PPE used when chasing brick or concrete.	2.1
11.	What type of drilling machine should be used when drilling masonry or concrete?	2.2/2.5
12.	What is the advantage of SDS drill bits over standard types?	2.1/2.3/2.5
13.	What tool is used to drive home the threaded pin in a nylon anchor?	2.5
14.	In what two forms is the chemical supplied for the chemical type fixings?	2.1/2.3
15.	Name two tools that can be used for chasing brick or concrete?	2.2/2.5
16.	What conditions need to be considered when selecting fixings for masonry or concrete?	2.1/2.3/2.6
17.	Are expansion anchors such as Dynabolts suitable for use near the edge of a concrete slab. If not, what is a suitable type to use?	2.1/2.3/2.6
18.	What is the main distinguishing feature of a specialised glass and ceramic drill bit?	2.1/2.2/2.6
19.	What types of materials would be suitable for fixings to be used outdoors?	2.3/2.6
20.	What Australian Standard refers to powder actuated fixing tools?	2.4
21.	According to the standard in Q20 what is the definition of a competent person and what is the clause number?	2.4

Q No.	Answer
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Solid Wall Practical

Task:

To affix a metal plate to a solid wall using three differing methods.

SAFE WORK PRACTISES MUST BE FOLLOWED

PPE MUST BE WORN

Aids Permitted:

Tool box
1x metal plate (pre-drilled)
1 x solid wall

Method:

Fix the pre-drilled metal plate to the solid wall. Ensuring that the metal plate is level and secure while making sure to use each of the following devices:

Masonry Screw
Plastic plug and screw
Dynalbolt

Feedback and Recommendations:

Student's Signature: _____ **Date:** _____

Assessor's Signature: _____ **Date:** _____

Metal

1. Metal comes in many shapes and sizes of which some types are shown below.

Figure 41 © Wikipedia
Sheet Metal Roofing

Figure 42 © Wikipedia
Steel Frame Wall

2. To affix to metal the main techniques are utilising the same techniques as for both hollow wall and solid wall. The main techniques are to use either screws, both into or through the metal, the use of nuts and bolts or other compression devices like rivets and hollow wall anchors.

3. As the main techniques are already covered earlier they will not be covered again. Other than to state that the main difference is that metal will need different methods of working it as it is different to both solid and hollow wall.

4. Working metal is a dangerous practice and care needs to be taken. Specifically care should be taken when drilling as sharp shards of metal (known as metal filings) are created and can be flung at high speeds into the air. Along with sharp waste material forming as the drill cuts, this being known as swarf.

5. When cutting metal to size the edges and the cutting tools are often sharp and some force is required. Creating hazard which can potentially result in injury, occasioning loss of appendages, or even death.

6. For this reason personal protective equipment must be worn when drilling. It is required that some eye protection must be worn and recommended that gloves be worn when handling along with hearing protection due to the loud noise that can be generated.

7. To minimise the sharp edges on a worked bit of metal, the material can be filled, if it is an edge needing smoothing or reamed to remove the burrs formed from drilling.

Figure 42
Metal Reamer

Figure 43
Metal File

Nut

8. As mentioned it is possible to affix to metal using nuts and bolts. The main way of doing so is by drilling a large enough hole through the materials in question. Feeding the bolt through and screwing on the nut on the other side until tight.

Figure 44
Metal Nut and Bolt

9. Typically nuts and bolts come in different lengths, thicknesses, threads, and head types. The head type whether it is hex head, cup head or Allen keyed, all work the same way but often using different tools.

10. The tools used in the installation of nuts and bolts are: drills, spanners, and depending on the head type screwdrivers and Allen keys.

Rivets

11. Another method to affix to metal is the use of rivets. Rivets are like bolts but without the thread end and designed to be a semi-permanent fixing.

12. Rivets are affixed by drilling a hole through the materials to be joined. Feeding the rivet through and then deforming the end so it holds the metal in place.

13. In the electrical industry the type of rivets we will be most commonly using are called blind/pop rivets.

Figure 45 © Bunnings Warehouse
Blind Rivets

14. Blind rivets are deformed by the use of a tool that pulls the metal mandrel stem into the rivet before snapping off the stem leaving the mandrel behind. This tool is often referred to as a pop rivet gun.

Figure 46 © Bunnings Warehouse
Rivet Gun

Metal Questions

		T No.
1.	Name two accessories that may be fixed to metal.	3.1
2.	Explain a technique for fixing to metal.	3.2
3.	Name four different methods for fixing to metal.	3.3
4.	Name the common tools needed when fixing to metal.	3.4
5.	List three items of PPE used with metal working and the reason why they are needed.	3.5

Q No.	**Answer**
1.	
2.	
3.	
4.	
5.	

Metal Practical

Task:

To affix to a metal plate a 20kg weight using an appropriate method.

SAFE WORK PRACTISES MUST BE FOLLOWED

PPE MUST BE WORN

Aids Permitted:

Tool box
1x metal plate
1 x 20kg weight

Method:

Fix to the metal plate the 20kg weight. Ensuring that the 20kg weight is secure. You have available to use of the following devices:

Metal Screw
Nuts and bolts
Rivets

Note: care must be taken when drilling and you must de-burr using a reamer.

Feedback and Recommendations:

Student's Signature: _____ **Date:** _____

Assessor's Signature: _____ **Date:** _____

Adhesives and Tapes

1. The methods of fastening are not limited to the broad ones already mentioned. There are multiple methods that are either proprietary or specific to a particular task.

2. The use of adhesives or tapes requires more prior thought and planning than the methods listed earlier in this book, as the limits for loads and uses are less forgiving.

3. An adhesive is a substance capable of holding material together by surface attachment and can be found in many different forms. The more common methods include the use of tapes or glues.

4. All adhesives work in a similar manner. Two materials are first cleaned, then the adhesive is applied and once applied the two materials are held together until the adhesive cures. Once the adhesive cures the materials will now be fastened to each other.

TAPES

5. Some trunking comes from the manufacture with double sided tape for easier fastening but it is possible to buy the tape separately and to use scissors or a knife to cut it to length.

Figure 47 © Clipsal
Double Sided Tape

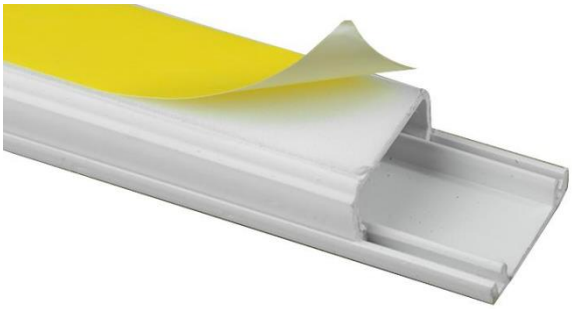

Figure 48 © Premier Farnell
Trunking with Double Sided Tape

6. The use of double sided tape requires the load to be placed on it to be quite low. It should be noted that the use of tape with trunking is often limited to a few small cables. This is due to the low load capability of the tape. The heavier the cables and the longer the run the less suited the use of double sided tape is.

EZIFIX

7. Ezifix fastening is a system incorporating 3M VHB tape. It requires the use of a primer and specialised tools to increase the safe working load up to 10kg.

Figure 49 © Ezifix
Ezifix Tools

Figure 50 © Ezifix
Ezifix saddles with Double Sided Tape

Figure 51 © Ezifix
Ezifix primer

8. Due to the limits of the tape's adhesion the applications for their use is limited primarily to hold cable.

EPOXY ADHESIVES

9. Is a common form of adhesive which is a glue consisting of an epoxy resin plus a hardener. In general, epoxies are known for their excellent adhesion, chemical and heat resistance, good to excellent mechanical properties and very good electrical insulating properties.

Figure 52 © Bunnings Warehouse
Epoxy

10. Common methods used during application include the use of brushes, rollers, spray guns or applicator guns (caulking gun).

Safety with adhesives

11. Adhesives often have components that are flammable and/or have toxic hazards. That may be irritable to the eyes and skin if direct contact occurs and cause irritation or allergic reactions. To prevent contact with the skin always wear appropriate gloves and long sleeve shirts.

12. The vapours from the adhesive may cause respiratory irritation. Ventilation must be provided in order to minimise contamination of the workplace atmosphere. The use of respirators must be considered and used if the situation requires.

13. You must keep adhesives away from heat, sparks and open flames because most solvents are flammable.

14. The use of adhesives will require the use of eye and face protection.

15. Before using any adhesive refer to the MSDS for that particular adhesive.

Adhesives and Tapes Questions

		T No.
1.	Name three main types of adhesives and tapes.	4.1
2.	Name four accessories that may be fixed using adhesives and tapes.	4.2
3.	Explain a technique for using adhesives and tapes.	4.3
4.	Name the common tools needed when using adhesives and tapes.	4.4
5.	List three items of PPE used with adhesives and tapes and the reason why they are needed.	4.5

Q No.	**Answer**
1.	
2.	
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