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SPARKS Magazine – Autumn Issue 2018 - Answer Sheet

Page 44 – Cable selection

1. Cable voltage ratings for cables to BS5467, thermosetting insulated, armoured cables with a conductor operating temperature of 90°C are:

Answer: 600 / 1000V and 1900 / 3300V *(Table 4A3)*

2. PVC insulated non-armoured cable to BS6004, rated at 450 / 750V with a conductor operating temperature of 70°C is suitable for?

Answer: electric power, lighting and internal wiring (fixed installation) *(Table 4A3)*

3. Cables having low emission of smoke and corrosive gases when affected by fire can be abbreviated using the letters?

Answer: LSF

4. Thermosetting insulted armoured cables for voltages of 600 / 1000V with low emission of smoke and corrosive gases and conductor operating temperature of 90°C, is British Standard?

Answer: BS6724 *(Table 4A3)*

5. 300 / 500V screened electric cables to BS8436 are for use in?

Answer: walls, partitions and building voids. *(Table 4A3)*

6. The maximum voltage recommended for Mineral insulated cables and their terminations, to BS EN 60702-1 is?

Answer: 750V *(Table 4A3)*

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Page 45 – Cable selection

1. The Table reference for current rating and voltage drop of 60°C thermosetting insulated flexible cable is:

Answer: 4F1A and 4F1B

2. The percentage voltage-drop allowance for a lighting circuit supplied from a private generator is:

Answer: 6% (*Table 4Ab*)

3. The Rating factor for ambient temperature (Ca), of a 60°C Mineral Insulated cable covered or exposed to touch is?

Answer: 0.45 (*Table 4B1*)

4. The Rating factor for a single layer of 12 x PVC insulated multicore cables supported on a cable ladder is?

Answer: 0.78 (*Table 4C1*)

5. The maximum current rating of a 3-phase 400V, 25mm² multicore 70°C thermoplastic non-armoured cable fixed to cable tray is?

Answer: 101A (*Table 4D2A Column 9*)

6. The maximum voltage drop per metre for the 25mm² in question 5 above, when supplying a resistive load is?

Answer: (r) 1.75mV/A/m (*Table 4D2B*)

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7. A 2-core, 10mm², 90°C thermosetting insulated flexible cable with protective conductor, supplying a single-phase load, has a maximum current rating and voltage-drop of?

Answer: 76A (*Table 4F2A*) and 5.1mV/A/m (*Table 4F2B*)

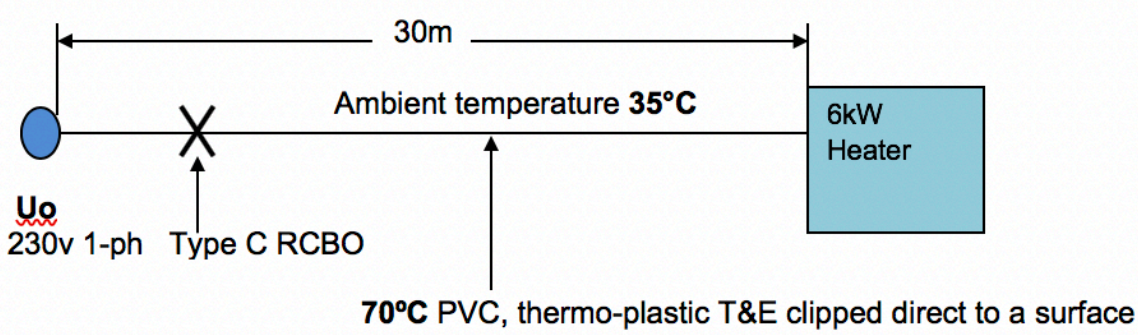
8. A 50mm², 90°C multicore armoured cable with thermosetting insulation and aluminium conductors, installed to Reference Method D supplying a single-phase load has a maximum current rating of?

Answer: 128A (*Table 4J4A*)

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Ib	26A
In	32A

Calculated or referenced

Chosen from Figure 3A5 Appendix 3

Cable Factor

Ca	0.94
Cg	N/A
Ci	N/A
Cf	N/A

Table Reference (BS7671)
4B1

Cable installation reference method	C

Total rating factor:	Current Carrying Capacity of cable required: **(It)**
C = Ca ~~x Cg x Ci x Cf~~ Only Ca applies	**It = In / C** It = 32 / 0.94 = **34A**

Cable size

Table No.	4D5
Column	6
Current rating	37A
Cable size	**4.0mm²**

Voltage drop

Table No:	4D5
Column	8
Voltage drop	**11 mV/A/m**

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Page 47 – Wiring containment systems

1. Bus-bar trunking systems must comply with which British Standard?
Answer: BS EN 61439-6 *(Chapter 52 521.4)*

2. A ferromagnetic enclosure is one that is fabricated from?
Answer: Steel

3. When access holes are made in steel trunking for the purpose of taking cables from the trunking to an electrical accessory what precautions must be taken?
Answer: (i) Cables must not be in direct contact with the edges of the hole/s. The hole/s must be bushed, or another wiring containment system such as conduit can be installed to allow circuit cables to pass safely into or from the trunking.
(ii) All cables belonging to the same circuit must pass through a single hole. In other words circuits must not be split-up and cables of that circuit passed through different holes. *(Chapter 52 522.8)*

4. In trunking systems cables of different Band circuits must be?
Answer: Kept separate. A compartmentalised trunking should be used or two **or** more trunking systems installed. *(Chapter 52 521.8.1)*

5. The use of inspection fittings in a steel or PVC conduit system is designed to enable?
Answer: Cables to be installed more easily and to minimise damage to the cable insulation during installation. It may be necessary, if there is sufficient space, to install new circuits in the future and inspection accessories will permit this to be carried out more easily. *(Chapter 34 341.1 (iii))*

6. Where non-combustible material is specified, the type of wiring containment to be used will be?
Answer: ferrous metal, e.g. steel. *(Chapter 42)*

7. One example of a closed wiring system for cables is?
Answer: Conduit *(Part 2 Definitions)*

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8. The term used to describe an enclosure situated above or in the ground, that is not large enough for persons but suitable for cables and conduits throughout their length is?

Answer: A cable channel *(Part 2 Definitions)*

9. The maximum internal cross-sectional area for a cable ducting or trunking that does not require it to be internally sealed to prevent flame propagation is?

Answer: 710mm^2 *(Chapter 52 527.2.3)*

10. A metal conduit or electrically continuous support system, (e.g. cable tray or cable ladder) can be used as a?

Answer: Protective conductor *(Chapter 54 543.2.1 (vi))*

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Q1	A wiring system that is identified by its diameter is which one of the following?	**Answer**
a	Standard power cables	
b	Standard conduits	X
c	Trunking	
d	MICC cables	

Q2	Stainless steel conduit or trunking is most likely to be specified for which situation?	**Answer**
a	Laboratory dealing with health screening samples	X
b	Commercial servicing garage	
c	Supermarket food-hall	
d	Domestic kitchen	

Q3	The cable capacity rating for trunking allows for?	**Answer**
a	Additional cables to be installed at a later date	
b	Expansion of cables when in use	
c	Sufficient cable temperature rise without damage	
d	Circulating air space allowing cables to shed heat in use	X

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Q4	Protective bonding straps are used on?	Answer
a	Conduit systems	
b	The ends of the containment	
c	Joints in trunking, cable tray or metal ducting	X
d	Joints on PVC conduit and trunking systems	

Q5	The accessory used to join lengths of metal trunking is a?	Answer
a	Connector	X
b	Screwed sleeve	
c	Joiner	
d	Coupler	

Q6	The terms 'kick' and 'off-set' are normally associated with…	Answer
a	Conduit systems	X
b	Trunking	
c	Cable tray	
d	Ducting	

Q7	The best practice method for connecting metal conduit to a metal-clad light switch accessory box is?	Answer
a	Threaded coupler and male brass bush	X
b	PVC conduit	
c	Direct connection of the conduit with the box using lock-nuts	
d	Flexible conduit	

Q8	Which one of the following containment systems is generally used underground?	Answer
a	Trunking	
b	Cable tray	
c	Conduit	
d	Ducting	X

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Q9	Spacer-bar, distance and hospital, are all types of?	Answer
a	Conduit	
b	Trunking support mechanisms	
c	Saddle	X
d	Support bracket	

Q10	Which one of the following wiring systems requires the introduction of fire barriers where it penetrates floors or ceilings?	Answer
a	Conduit 25mm and above	
b	Trunking with an area of over 710mm²	X
c	Cable tray	
d	Cable basket	

Q11	Cable basket is designed to support all of the following cable types except?	Answer
a	Single PVC insulated cables	X
b	PVC SWA	
c	PVC insulated MICC	
d	CAT 5 data cable	

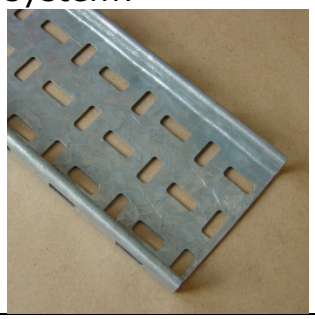
Q12	A running – coupler is used when?	Answer
a	PVC conduit systems	
b	Trunking installations	
c	Underground ducting	
d	A steel conduit cannot be turned in situ	X

Q13	The recommended saddle that permits cleaning behind the attached conduit is a?	Answer
a	Distance saddle	X
b	Spacer- bar saddle	
c	Crampet	
d	Clip	

Q14	Stock, die, reamer and bending machine are specialist tools use on which wiring system?	Answer
a	PVC conduit	
b	Steel conduit	X
c	Steel trunking	
d	Metallic cable tray	

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Q15	Which one of the following wiring support systems can be suspended from the building structure?	Answer
a	Steel conduit	
b	Ducting	
c	PVC conduit	
d	Cable tray	X

Q16	The image shows what type of cable support system? 	Answer
a	Galvanised cable tray	X
b	Galvanised ducting	
c	Light - gauge plate	
d	Admiralty pattern black enamel cable tray	

Page 51 – Steel containment systems

Question 1
Identify the correct name for each of the following steel cable containment systems and suggest one application:

a

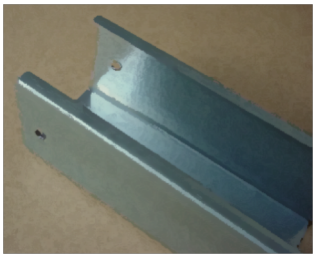


Cable basket

Supporting multi-core cables; for inside use

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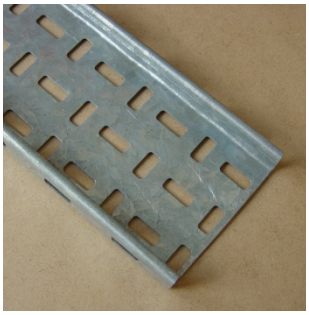
b



Galvanised steel trunking *(no lid shown)*

Enclosing single and multi-core cables; for inside use

c



Galvanised heavy-duty cable tray

Supporting PVC SWA cables; for inside or outside use

d



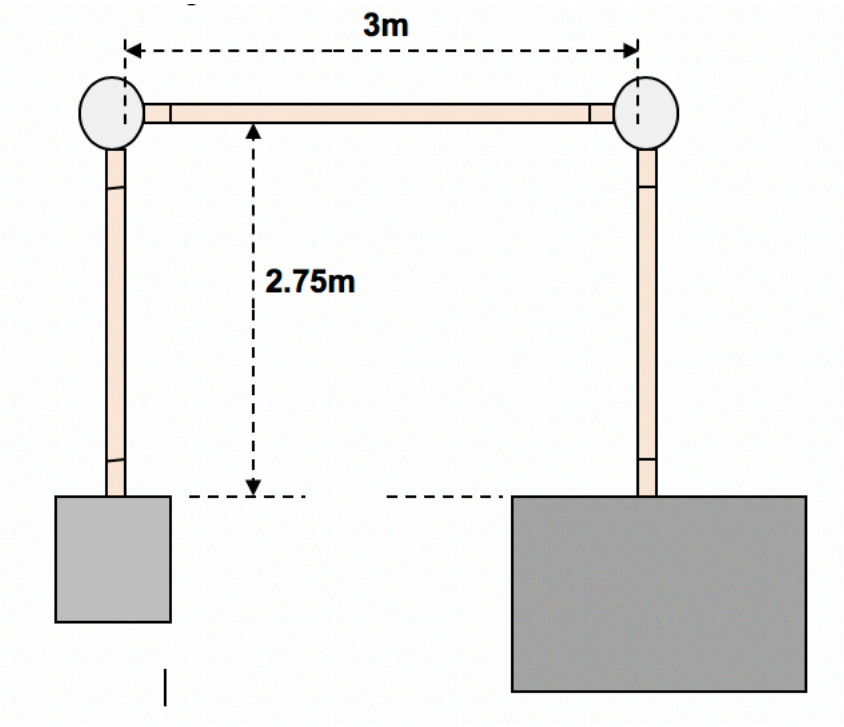
Black enamel steel conduit *(Seam welded)*

Enclosing single insulated cables; only for use indoors in dry, corrosion free environments

Question 2

Estimate the amount of steel conduit required for the following installation in total metres and lengths.

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Answer:

Total length without making adjustments for the conduit fittings is:-

3+(2.75 x 2) = **8.5m**

A total of 3 length of conduit should be specified. (Standard length 3.75M)

Page 52 – Steel containment systems

Question 3

By using the IET On-Site Guide find and state the cable factors for each of the following cable types and installation methods:

a) 2.5 mm^2 PVC insulated cable with solid conductors installed in a straight length of galvanised steel conduit.

39 Table **E1**

b) 10 mm^2 PVC insulated cables with stranded conductors installed in a 2m length of galvanised steel conduit.

146 Table **E1**

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c) 10 mm^2 PVC insulated cables with stranded conductors installed in a 4m length of galvanised steel conduit.

105 Table **E3**

Question 4

Determine a suitable size of conduit to accommodate the following cables in a 2.8 m straight run of steel conduit:

- 3 x 1.5 mm^2 (stranded conductors)
- 2 x 4.0 mm^2
- 1 x 10.0 mm^2
- 2 x 16.0 mm^2

Answer:

Use **Tables E1** and **E2** to find a suitable size of conduit.

	Cable factor (Table E1)	**Total cable factor**
• 3 x 1.5 mm^2	27	27 x 3 = 81
• 2 x 4.0 mm^2	58	58 x 2 = 116
• 1 x 10.0 mm^2	146	= 146
• 2 x 16.0 mm^2	202	202 x 2 = 404
		Total factor = **747**

From **Table E2** a total factor of 747 is not listed so therefore the next rating up must be chosen, in this case the next factor is 800 for a **25 mm** Dia. conduit

Question 5

How many 25 mm^2 copper cables can be installed in a 2m length of 25 mm Dia. conduit?

Answer:

From **Table E2** the total cable factor for a 25 mm conduit is 800

Next find the cable factor for a 25 mm^2 cable. **Table E1** gives this as 385

Finally divide 800 by 385 and the answer is: **2 cables**

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Page 53 – Steel containment systems

Question 6:
The next question concerns cables installed in a steel conduit that is 5 m in length with one 90º bend and two off-sets.

Note: one off-set is equivalent to one bend

Determine a suitable size of conduit to accommodate the following cables

- 3 x 1.5 mm^2 (solid conductors)
- 3 x 4.0 mm^2 (solid conductors)
- 2 x 10.0 mm^2 (stranded conductors)

Answer:

From **Table E3** the following cable factors are obtained:

Note: cables can be stranded or solid conductor in Table E3

	Cable factor (Table E3)	Total cable factor
• 3 x 1.5 mm^2	22	3 x 22 = 66
• 3 x 4.0 mm^2	43	3 x 43 = 129
• 2 x 10.0 mm^2	105	2 x 105 = 210
		Total factor = **405**

From **Table E4** find the conduit length in the left – hand column, (5 m), read across the row to the section headed **3 bends** (i.e. one 90º and 2 off-sets), the nearest rating is **474** and this is for a **32 mm** Dia. conduit.

Question 7:
Determine the number of 16 mm^2 with thermosetting insulation that can be installed in a 50 mm x 50 mm galvanised steel trunking.

Answer:

From **Table E6** for a 50 mm x 50 mm trunking the total factor is **1037**

From **Table E5** the cable factor for a 16 mm^2 thermosetting cable is **50.3**

The total number of cables that can be installed is: $\frac{1037}{50.3}$ = **20.61 cables**

In practice a total of **20** cables will be assumed.

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Question 8:

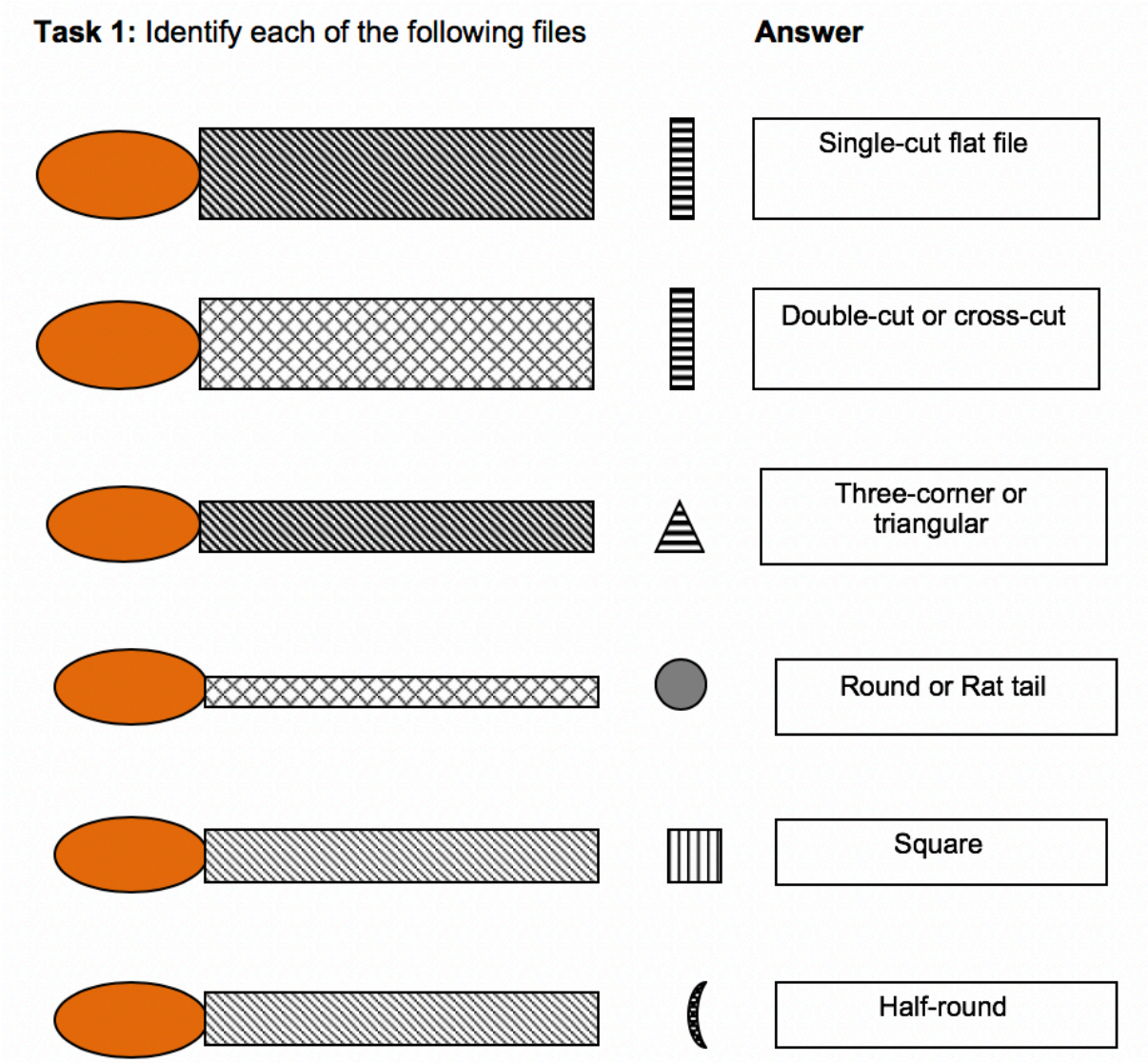
What is the **minimum internal bend** radius for a 25 mm conduit?

Answer:

2.5 x the outside diameter of the conduit. *(See beneath Table E3)*

2.5 x 25 = **62.5 mm**

Page 54 – Hand tools / files

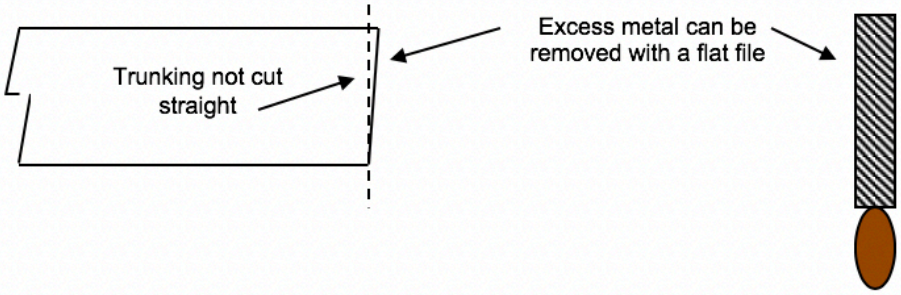


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Task 2: By using **two examples** describe the purpose of a file.

Answer:
i) A file is used to remove excess metal using a physical action. For example the removal of burrs from the cut ends of conduit, trunking and cable tray.

ii) If for example the cut edge of a section of steel trunking is uneven a flat file can be used to remove unwanted metal and thereby make the edge level or straight.



Page 55 – Hand tools / files

Task 3: Identify **three** different surface finishes of flat files

Answer:

1) Rough; these files have very course teeth that are cut across each other and are designed to remove large quantities of material.

2) Second cut files have teeth cut one way only and are designed to cut equal layers of material with the result the finish is generally smoother than that of the rough cut file.

3) A smooth file will have shallow cut teeth compared to the other files mentioned above, the resulting cut is a smooth fine finish to the work-piece

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Task 4: Give **two** ways in which a file could be damaged

Answer:

1) Files are made from high carbon steel that is heat treated and becomes very hard and brittle. A file can easily be broken if handled incorrectly. Excessive pressure, twisting or levering the file is likely to result in it snapping.
2) If a file is in contact with another hardened surface the teeth will be damaged. This can occur if files are stored together in a tool-box without protection.

Task 5: Sometimes the teeth of a file become clogged with metal particles, *(swarf);* briefly explain how a file can be cleaned and any precautions that must be taken in this procedure.

Answer:
To clean out the swarf a tool called a **file – card** may be used. Alternatively a stiff wire brush can be just as effective.
NOTE:
Always wear eye protection when performing this task as small metal particles can fly-upwards.

Task 6: Suggest **<u>three</u>** safety observations that should be adopted when using hand - files

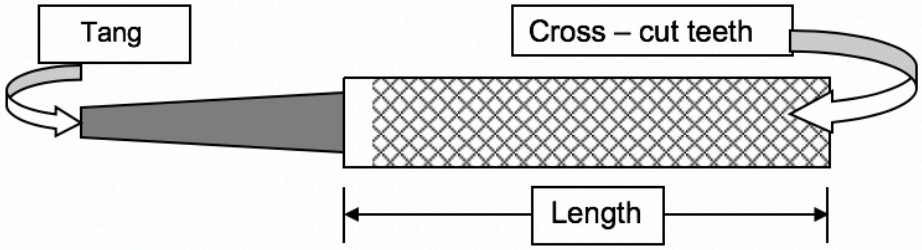
Answer:

1) Never us a file without a handle, if the file jambs on the forward stroke the sharp pointed end, called the' tang' is liable to push into your wrist.

2) If a handle comes off it is best to fit a new one, if this is not possible then try to reuse the old handle but follow the same procedure as fitting a new one,

3) Never use a broken or blunt file

Task 7: Label the following diagram of a flat file



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Page 56 – Wiring containment systems

1. State **three** types of surface finish that can be specified for steel conduit.

Answer: i) Black enamel ii) Galvanised iii) Stainless steel

2. For **each** of the following locations suggest the most appropriate surface finish of steel conduit to be installed:

a) A lighting installation in a warehouse storing dry goods
Answer: Black enamel

b) A security lighting system on the outside walls of a school building
Answer: Galvanised

c) A power and lighting installation in a commercial food preparation location
Answer: Stainless steel

3. Cable tray and cable basket provide support for which types of electrical service cables?
Answer: PVC steel wire armoured, FP200 and equivalent, Mineral insulated cables and any other cable with reinforced insulation.

4. Steel trunking is generally used to provide mechanical protection for which type of cable?
Answer: Single or multi-core, insulated non-armoured cables.

5. a) State the requirements for a.c. circuits installed in ferromagnetic enclosures.
Answer: All line conductors and the neutral conductor, if any, must be contained in the same enclosure.

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5. b) Name the effect that may be caused if all line and any associated neutral conductors are not contained in the same ferromagnetic enclosure.

Answer: Eddy currents can be created in the metallic enclosure of the ferromagnetic wiring system this will result in heat being generated in the enclosure and subsequent damage to the cables and possibly the fabric of the building to which the enclosure is mounted.

6. Identify the following British Standards associated with steel wiring containment systems

a) BS EN61386 - Cable conduits
b) BS EN50085 - Cable trunking or ducting
c) BS EN61537 - Cable tray and ladder systems

Page 57 – Wiring containment systems and wordsearch

7. Identify the minimum degree of protection, (IP) rating when non-sheathed cables are permitted to be enclosed in a cable trunking system.

Answer: IPXXD or IP4X (See 521.10.1 paragraph 2 BS7671: 2008 Amd 3 2015)

8. Give **one** example where flexible conduit can be used in an industrial location where electrical machines are installed.

Answer: Flexible conduit is used to connect the fixed conduit installation to an electric motor.

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Wiring containment systems wordsearch

A	L	C	X	G	I	K	L	W	Q	C	R	T	S	A	D	D	L	E	H
T	E	N	A	M	E	L	X	S	C	R	E	W	E	R	I	V	E	R	A
S	V	E	D	C	S	O	E	S	U	U	S	O	C	T	G	Z	N	E	C
P	B	U	A	F	X	C	O	U	P	L	E	R	N	S	S	M	G	K	K
A	L	I	P	E	G	K	A	N	T	T	N	M	A	Y	C	N	O	D	S
C	A	W	T	L	M	N	L	I	E	R	S	R	T	C	A	B	L	E	S
E	P	Q	O	B	S	U	P	P	O	R	T	U	S	D	B	E	G	D	W
R	A	U	R	I	H	T	C	E	S	S	E	U	I	E	L	O	L	E	L
B	N	C	Z	X	S	S	L	V	R	B	E	N	D	I	E	C	E	S	E
A	H	W	A	E	L	H	E	E	B	N	L	R	P	S	B	U	S	H	E
R	E	Y	M	L	S	A	W	Q	O	K	P	K	J	L	A	A	S	L	C
R	A	A	M	F	N	L	G	G	A	L	V	A	N	I	S	E	D	I	J
B	D	R	E	A	D	L	F	N	T	V	R	S	E	R	K	G	G	T	N
H	F	T	R	D	U	C	T	I	N	G	S	P	A	N	E	E	R	P	V
E	Z	E	S	U	G	N	X	K	F	T	F	E	G	G	T	R	I	I	D
H	A	L	D	L	A	M	P	N	I	I	W	N	N	S	N	Y	N	N	N
M	I	B	A	E	N	C	A	U	T	L	A	C	U	T	B	I	D	C	E
D	R	A	L	L	P	I	N	R	A	C	K	I	N	E	A	A	E	U	B
I	A	C	O	N	D	U	I	T	G	I	N	S	P	E	C	T	I	O	N
O	S	F	T	A	P	E	M	A	A	S	U	R	E	C	M	Y	L	E	S

Page 60 – Hand and power tools wordsearch

A	L	C	X	G	I	K	L	W	Q	C	R	T	H	I	J	N	M	T	H
T	E	R	M	I	N	A	L	S	C	R	E	W	D	R	I	V	E	R	A
R	V	E	R	C	S	T	E	S	U	U	S	O	N	T	G	Z	N	E	C
A	E	U	L	F	X	V	G	K	T	N	U	E	L	S	S	M	G	K	K
N	L	I	J	P	G	Q	A	N	T	T	N	M	E	Y	A	N	O	D	S
S	A	W	F	V	M	P	L	I	E	R	S	R	A	F	W	T	G	B	A
F	P	Q	N	F	W	Q	U	F	R	R	T	U	N	D	H	E	G	D	W
O	A	U	V	L	H	L	C	E	S	S	R	U	L	E	R	O	L	E	L
R	N	C	H	I	S	E	L	V	R	I	I	C	O	I	I	C	E	S	E
M	H	A	A	M	L	H	E	A	B	N	P	R	P	S	T	H	S	P	E
E	E	C	M	H	S	A	W	K	O	K	P	K	J	L	O	A	S	L	C
R	A	D	M	A	N	L	G	L	O	V	E	S	H	F	O	R	T	I	J
B	D	L	E	A	D	L	F	E	T	V	R	S	E	R	I	G	G	T	N
H	F	P	R	V	T	E	V	D	S	W	S	P	A	N	N	E	R	P	V
E	Z	Y	S	U	G	N	X	I	F	T	F	E	G	G	O	R	I	I	I
H	A	N	D	L	A	M	P	S	I	I	W	N	N	S	N	Y	N	N	O
M	I	A	A	E	N	C	A	S	T	L	A	C	U	T	B	I	D	C	Q
D	R	I	L	L	I	N	G	M	A	C	H	I	N	E	A	A	E	U	N
I	A	C	E	F	R	E	B	S	G	S	J	L	O	L	E	B	R	P	Z
O	S	F	T	A	P	E	M	E	A	S	U	R	E	C	M	Y	L	E	S

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