

Level 2 Certificate in Forgework (8485-02)

September 2017 Version 1.2

QUALIFICATION HANDBOOK



Qualification at a glance

Subject area	Forgework
City & Guilds number	8485-02
Age group approved	16+
Entry requirements	Level 2
Assessment	E-volve test, Portfolio, Practical exam
Fast track	Available from 7485 Certificate in Forgework
Support materials	Centre handbook Assessment pack
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds number	Accreditation number
Level 2 Certificate in Forgework	236	300	8485-02	600/5740/3

Version and date	Change detail	Section
1.2 September 2017	Added TQT details Deleted QCF	Qualification at a glance and Structure Throughout



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1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	For candidates who work or want to work in the forgework industry.
What does the qualification cover?	It allows candidates to learn, develop and practise the skills required for employment and/or career progression in the forgework industry.
Is the qualification part of a framework or initiative?	This qualification could be used as a pre-farriery apprenticeship course.
What opportunities for progression are there?	It could allow candidates to progress onto the Farrier Apprenticeship framework

Structure

To achieve the Level 2 Certificate in Forgework, learners must achieve **30 credits** from the mandatory units listed in the table below.

Level 2 Certificate in Forgework

Mandatory				
Unit accreditation number	City & Guilds Unit no.	Unit title	Credits	GLH
F/504/0680	001	Know the principles of forgework	5	40
L/504/0682	002	Undertake forgework techniques and processes	20	150
J/504/0681	003	Producing forgework pieces to industry standards	5	46

Total Qualification Time

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT
Level 2 Certificate in Forgework	236	300



2 Centre requirements

Approval

Centres that are approved to offer the 7485 L2 Certificate in Forgework qualification can apply for the new 8485 L2 Certificate in Forgework approval using the **fast track approval form**, available from the City & Guilds website.

Centres should use the fast track form if:

- there have been no changes to the way the qualifications are delivered, and
- they meet all of the approval criteria in the fast track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After 12 months, the Centre will have to go through the standard Qualification Approval Process. The centre is responsible for checking that fast track approval is still current at the time of application.

Existing centres who wish to offer this qualification and were not approved to offer the 7485 L2 Certificate in Forgework must use the **standard** Qualification Approval Process.

New centres will need to gain both centre and qualification approval to offer this qualification. Please refer to the *Centre Manual - Supporting Customer Excellence* for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Resource requirements

Physical resources and site agreements

Centres can use specially designated areas within a centre to assess. The equipment, systems and machinery must meet industrial standards and be capable of being used under normal working conditions.

Centre staffing

Staff delivering this qualification must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area for which they are delivering training and/or have experience of providing training. This knowledge must be at least to the same level as the training being delivered

- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors and internal verifiers

The centre must provide Assessor personnel who must be occupationally competent in the industry either qualified to at least level 2 (the same level as the qualification being referred to) and/or have current experience of working in the industry at this level.

The centre must provide Internal Quality Assurance personnel who must be occupationally competent in the land-based sector either qualified to at least level 2 (the same level as the qualification being referred to) and/or have current experience of working in the industry at this level.

Assessors/Internal Quality Assurance personnel may hold relevant qualifications such as D32/33/34 or A1/V1 or TAQA however they are not a mandatory requirement for this qualification. They should have had formal training in assessment/IQA, which may be the qualifications above, or other training that allows the assessor to demonstrate competence in the practice of assessment/IQA. This training may be carried out in-house or with an external agency.

TAQA qualifications are considered very appropriate as Continuing Professional Development (CPD) or as best practice standards for new centre staff to work towards.

Continuing professional development (CPD)

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice, and that it takes account of any national or legislative developments.

Candidate entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully.

Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as this qualification is not approved for under 16s.



3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs,
- support and guidance they may need when working towards their qualification[
- any units they have already completed, or credit they have accumulated which is relevant to the qualification
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for this qualification:

Description	How to access
Practical exam administration documents	www.cityandguilds.com
fast track approval forms/generic fast track approval form	www.cityandguilds.com



4 Assessment

Assessment of the qualification

Unit Number	Unit Title	Assessment method
001	Know the principles of forgework (Level 2) (5)	E-volve test
002	Undertake forgework techniques and processes (Level 2) (20)	Portfolio
003	Producing forgework pieces to industry standards (Level 2) (5)	Practical exam

Test specifications

The way the knowledge is covered by each test is laid out in the table] below:

Test 1: Unit 001
Duration: 1 hour

Unit	Outcome	Number of questions	%
001	1	10	33
	2	8	27
	3	12	40
Total		30	100



5 Units

Structure of units

These units each have the following:

- City & Guilds reference number
- unit accreditation number
- title
- level
- credit value
- unit aim
- relationship to NOS, other qualifications and frameworks
- endorsement by a sector or other appropriate body
- information on assessment
- learning outcomes which are comprised of a number of assessment criteria

Unit 001

Know the principles of forgework

UAN:	F/504/0680
Level:	Level 2
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is relates to SEMPEO2-55 Carrying out hand forging of engineering materials.
Endorsement by a sector or regulatory body:	This unit is supported by Semta, the Sector Skills Council for Manufacturing.

Learning outcome
The learner will: 1 Know the common forge equipment and tools
Assessment criteria
The learner can: 1.1 identify forge tools and equipment for specified processes 1.2 identify parts of a solid fuel hearth 1.3 identify parts of a gas hearth 1.4 describe the operational principles of solid fuel and gas hearth.

Range
Forge tools and equipment: <ul style="list-style-type: none">• Hand hammer.• Tongs.• Rule.• Punches.• Hot chisel.• Wire brush.• Top and bottom tools.• Rasp.• Anvil.• Leg vice.
Solid fuel hearth: <ul style="list-style-type: none">• Coke side blast.
Gas hearth: <ul style="list-style-type: none">• Venturi gas.

Operational principles:

- Area of fire – oxidising, neutralising and reducing.
- Control methods to produce working heats.
- Relevant legislation.
- Personal Protective Equipment (PPE).
- Working safely.
- Management and maintenance of hearth.

Learning outcome

The learner will:

2 Know health and safety requirements in the forge

Assessment criteria

The learner can:

- 2.1 state the **health and safety responsibilities** of a forge worker
- 2.2 identify **risks and hazards in the forge work environment**
- 2.3 identify risks and hazards in forge work processes.

Range**Health and safety responsibilities:**

- Use of Personal Protective Equipment (PPE).
- Relevant health and safety legislation.

Risks and hazards in the forge work environment:

- Heat
- Fumes.
- Obstacles in the work area.
- Dust.
- Noise.
- Impact injuries.
- Use of tools.

Risks and hazards in forge work processes:

- Solid fuel and mobile gas furnaces.
- Forming operations.
- Cutting and punching tasks.
- Management.
- Maintenance and control of the forge.
- Tool use.
- Materials used.

Learning outcome
The learner will: 3 Know the materials, methods and techniques for forge work
Assessment criteria
The learner can: 3.1 identify appropriate visual metal heats 3.2 describe the forging techniques for given tasks 3.3 state the effects of forging techniques on mild steel 3.4 explain the effects of heating and cooling on metal 3.5 state the characteristics of steel for specified tasks.

Range [include where required, otherwise delete]
<p>Visual metal heats</p> <ul style="list-style-type: none"> • Black. • Red. • Orange. • Yellow. • Heat treatments. <p>Forging techniques</p> <ul style="list-style-type: none"> • Refer to forging exercise book. • Forming techniques. • Hot cutting and punching of mild steel by hand eg slot/ taper punches, drift/slitter punches, hot chisel/ hot set. • Working to specifications. • Appropriate tool use. • Assembly techniques. • Heat treatments. <p>Forging techniques on mild steel</p> <ul style="list-style-type: none"> • Grain deformation. • Introduction of galls/ forging faults. • Bending and twisting – grain structure. • Mean line. <p>Heating and cooling on metal</p> <ul style="list-style-type: none"> • Scaling. • Burning. • Basic metallurgy of plain carbon steel. <p>Characteristics of steel</p> <ul style="list-style-type: none"> • Basic metallurgy of plain carbon steel.

Unit 002

Undertake forgework techniques and processes

UAN:	L/504/0682
Level:	Level 2
Credit value:	20
GLH:	150
Relationship to NOS:	This unit relates to SEMPE02-55 Carrying out hand forging of engineering materials.
Endorsement by a sector or regulatory body:	This unit is supported by Semta, the Sector Skills Council for Manufacturing.

Learning outcome
The learner will: 1 Be able to use forge work techniques and processes
Assessment criteria
The learner can: 1.1 identify appropriate techniques and processes for forge work task 1.2 use forging, forming, cutting and joining techniques safely to produce forgework pieces.

Range
Techniques and processes <ul style="list-style-type: none">Control methods to produce the working heats on mild steel.
Forging, forming, cutting and joining techniques <ul style="list-style-type: none">Use hearth to heat metal:<ul style="list-style-type: none">control fire heat and size for specific tasksapply safe working practices including use of personal protective equipment (PPE)hazards and risksrisk assessment.Upsetting, drawing down, spreading, setting down, bending and twisting techniques.Correct selection of tools.Use correct working heats, including appropriate use of spot heat techniques.Control section dimensions and surface quality during the

forming process.

- Cut or split mild steel, punch holes.
- Use specification for pieces.
- Produce separate elements.
- Assemble finished artefact from elements.
- Inspect and test artefact is fit for purpose.

Learning outcome

The learner will:

- 2 Be able to use forge work techniques and processes to produce forge work artefacts to specification

Assessment criteria

The learner can:

- 2.1 **produce** the following forge work artefacts:
- a) forging to section (flat, square and round)
 - b) forging points (chisel, square, round and diamond)
 - c) staple – flat
 - d) unwelded eye – round
 - e) flat ring
 - f) figure 8 - round
 - g) set eye hook
 - h) bow shackle (large, set eye)
 - i) tie bar
 - j) flat bit tongs.

Range

Produce

- Use hearth to heat metal:
 - control fire heat and size for specific tasks
 - apply safe working practices including use of personal protective equipment (PPE)
 - hazards and risks
 - risk assessment.
- Upsetting, drawing down, spreading, setting down, bending and twisting techniques.
- Correct selection of tools.
- Use correct working heats, including appropriate use of spot heat techniques.
- Control section dimensions and surface quality during the forming process.
- Cut or split mild steel, punch holes.
- Use specification for pieces, produce separate elements, assemble finished artefact from elements, inspect and test artefact is fit for purpose.

Unit 003

Producing forgework pieces to industry standards

UAN:	J/504/0681
Level:	Level 2
Credit value:	5
GLH:	46
Relationship to NOS:	This unit relates to SEMPE02-55 Carrying out hand forging of engineering materials .
Endorsement by a sector or regulatory body:	This unit is supported by Semta , the Sector Skills Council for Manufacturing.

Learning outcome
The learner will: 1 Be able to work safely in a forge
Assessment criteria
The learner can: 1.1 use correct Personal Protective Equipment (PPE) 1.2 carry out the requirements of a risk assessment 1.3 carry out tasks with awareness of safety to self, others and the close working environment.

Range
Personal Protective Equipment (PPE) <ul style="list-style-type: none">• Safety spectacles (not ski-type goggles).• Steel toed-capped boots.• Ear defenders/ear plugs.• Overalls or leather apron.• Leather gloves.
Tasks <ul style="list-style-type: none">• Safety checks.• Risk assessment.• Cleaning.• Report faults.• Hazards include:<ul style="list-style-type: none">- heat- fumes- obstacles in work space- noise- dust- impact injuries.

Learning outcome

The learner will:

- 2 Be able to produce pieces to industry standards and specifications

Assessment criteria

The learner can:

- 2.1 select appropriate **tools** for given tasks
- 2.2 use appropriate **processes** for given tasks
- 2.3 produce pieces to **industry specifications**
- 2.4 produce pieces within **industry timescales**.

Range**Tools**

- Hand hammer.
- Tongs-flat bits to hold 6mm & 10mm stock (1/4" & 3/8").
- Tongs- hollow bits for 16mm square (5/8") and 20mm square (3/4").
- Steel or brass rule - 300mm (1 Foot) minimum. Avoid aluminium rules or those with the divisions printed on them.
- Wire brush.
- Butchers block brush is best but ordinary type will do.
- Centre punch.
- Stud punch - 10mm (3/8") or tapered round punch (and) 10mm (3/8") diameter drift.
- Bolster plate (optional) 10-12mm hole.
- Hot chisel.
- Cutting plate (optional).

Processes

- Forging (upsetting, drawing down, spreading and setting down).
- Forming (bending and twisting).
- Cutting (cut or split steel, punch holes).
- Joining (produce separate elements and assemble eg rivet, hinge plate).

Industry specifications

Within tolerance of specification, inspect and test artefact to ensure fitness for purpose.

Industry timescales

- Forging to section:
 - flat 30 minutes,
 - square 30 minutes,
 - round 30 minutes.
- Forging points:
 - chisel 15 minutes,
 - square 15 minutes,
 - round 20 minutes, diamond 20 minutes.
- Staple - flat 25 minutes.
- Unwelded eye - round 15 minutes.

- Flat ring 30 minutes.
- Figure 8 – round 25 minutes.
- Set eye hook 60 minutes.
- Bow shackle - large - set eye 60 minutes.
- Tie bar 60 minutes .
- Flat bit tongs 180 minutes.



Appendix 1 Relationships to other qualifications

Links to other qualifications

Literacy, language, numeracy and ICT skills development

This qualification] can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales – see www.cityandguilds.com/esw



FORGING EXERCISES FOR BLACKSMITHS AND FARRIERY APPRENTICES

REVISION 2

2006



ACKNOWLEDGEMENT

The design and content was produced by Mr H B Pomfret at Herefordshire College of Technology, based on the original booklet by Mr G T Sutton.

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INTRODUCTION

This book is intended to help potential blacksmiths and farriery apprentices to demonstrate a level of competence in basic forge techniques and processes. These techniques cover the forging and forming skills that are used in basic forging and shoe production.

IMPORTANT INFORMATION

Trainees are not expected to make the exercises in this publication without first being given instruction, demonstration and guidance.

It is for this reason that any instructions given here are brief and merely represent points to remember when working through the exercises.

It is also assumed that after suitable instruction, anyone attempting these exercises will be able to:

1. Practice and have knowledge of current Health & Safety regulations
2. Prepare and control a fire to the correct heat and size. If possible the student should have experience of using both solid fuel and gas hearths.
3. Hold and correctly use several types of hammer. There are opportunities to work as smith and striker with some of the exercises although it is recommended that the student first becomes adept with hand hammers.
4. Select and use tongs correctly to ensure safe and efficient working. Please note that badly fitting tongs are dangerous and can easily cause injury.
5. Identify the correct temperatures for forging, bending and finishing and be aware of the effects of heat and forging on the internal structure of the metal
6. Take, and control, heats on metal, of the required lengths and in the required positions, using both the forge hearth and water bosh as appropriate.
7. Be familiar with the various parts of the anvil and how they should be used when shaping metal.
8. Keep the fire, the metal and the anvil clean.
9. Acquire co-ordination between hand and eye, particularly when accurately forging sizes of stock material or bending complicated shapes.
10. Have confidence in working hot metal accurately and cleanly.

POINTS TO NOTE:

The objective is to complete all the exercises, (except where indicated for the Tie Bar), **WITHOUT the use of rasps or files.**

All the pieces can be produced as many times as is necessary for the potential apprentice and ATF or tutor to be satisfied that they can, during the forging test:

- a) be reproduced within the given time limits, and,
- b) be reproduced to the standard required.

TOOLS & EQUIPMENT

In the production of the exercises in this booklet, the student will need, (as a minimum), the following:

Personal Protective Equipment (PPE). Including:

Safety spectacles, (Not Ski type goggles).

Steel toecapped work boots.

Ear defenders or ear plugs.

Overalls or leather apron.

Leather gloves (optional).

Hand hammer .

Tongs - Flat bits to hold 6mm & 10 mm stock (1/4" & 3/8").

Tongs - Hollow bits for 16mm square (5/8") and 20mm square (3/4").

Steel or brass rule. 300mm (1 Foot) minimum. Avoid aluminium rules or those with the divisions printed on them

Wire brush. Butchers block brush is best but ordinary type will do.

Centre punch.

Stud punch -10mm (3/8").

Or tapered round punch (and) 10mm (3/8") diameter drift.

Bolster plate (optional) 10-12mm hole.

Hot chisel.

Cutting plate (optional).

CONVERSIONS

CONVERSION TABLE - METRIC TO IMPERIAL

These conversions are approximations for use as a guide.

For example, in certain circumstances, 5mm bar stock may be used in place of either 3/16" or 1/4" as 5mm lays somewhere between the two sizes.

As the size increases, so the accuracy decreases. For example, 300mm is used as the equivalent of one foot whereas the actual metric equivalent is 305mm, nearly 1/4" difference.

The student must familiarise him/herself with all the commonly used stock sizes and should be able to recognise them without the aid of a ruler.

1.5mm	_____	1/16"
3mm	_____	1/8"
4.5mm	_____	3/16"
6mm	_____	1/4"
8mm	_____	5/16"
10mm	_____	3/8"
12mm	_____	1/2"
16mm	_____	5/8"
20mm	_____	3/4"
22mm	_____	7/8"
25mm	_____	1"
50mm	_____	2"
75mm	_____	3"
100mm	_____	4"
150mm	_____	6"
200mm	_____	8"
250mm	_____	10"
300mm	_____	1' (1Foot)

MAXIMUM TIME LIMITS

MANDATORY EXERCISES	TIME LIMIT
1) FORGING TO SECTION	
FLAT	30 MINUTES
SQUARE	30 MINUTES
ROUND	30 MINUTES
2) FORGING POINTS	
CHISEL	15 MINUTES
SQUARE	15 MINUTES
ROUND	20 MINUTES
DIAMOND	20 MINUTES
3) STAPLE - FLAT	25 MINUTES
4) UNWELDED EYE - ROUND	15 MINUTES
5) FLAT RING	30 MINUTES
6) FIGURE 8 - ROUND	25 MINUTES
7) SET EYE HOOK	60 MINUTES
8) BOW SHACKLE - LARGE - SET EYE	60 MINUTES
9) TIE BAR	60 MINUTES
10) FLAT BIT TONGS	180 MINUTES
<hr/>	
OPTIONAL EXERCISES	TIME LIMIT
1) FORGING TO SECTION - SET DOWN SECTIONS	60 MINUTES
2) STAPLE - ROUND	20 MINUTES
3) UNWELDED EYE - FLAT	30 MINUTES
4) FIGURE 8 - FLAT	35 MINUTES
5) BOW SHACKLE - SMALL - TURNED EYE	35 MINUTES
6) HEART - UPSET RIGHT ANGLE BEND	60 MINUTES

MANDATORY EXERCISE 1

FORGING TO SECTION

STOCK: OLD HORSE SHOES

PLEASE NOTE

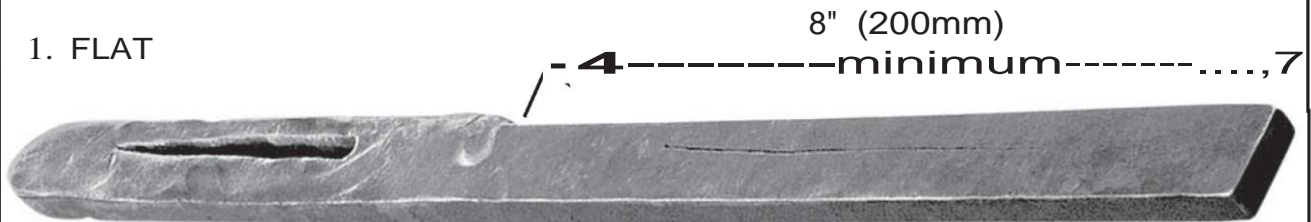
You may forge to a size of your own choosing but the forged section must be **at least 8"** (200mm) long

OBJECT:

After straightening the shoe, to forge a **minimum** of 8 inches (200mm) of parallel section.

This section is to be as free of hammer marks as possible and to have a clean finish

1. FLAT



Take a long yellow heat and forge with overlapping blows, working along the bar. Forge the edges in to achieve the flat section. As the section develops, reduce the heat to the orange range and finally through the reds to finish.

Check that the width is constant along the length frequently, that the bar is straight and that the sides are at right angles to each other

2. SQUARE



As with the flat section but you will need to turn the metal often to maintain an even section. The forged section must be straight, parallel and square.

3. ROUND



To forge a round section you must first forge a square section which must be even, straight and true.

Then forge in the corners from end to end until you have an octagonal (8 sided) section. If some flats are wider than others then you do not have a true octagon.

Only when this step is complete, forge in the corners of the octagon along the length. **DO NOT** try to round up before this point.

At a finishing heat and with lighter blows, round up by slowly rotating the piece under the hammer

MANDATORY EXERCISE 2

FORGING POINTS - CHISEL, SQUARE, ROUND, DIAMOND



STOCK:
5" OF 5/8 SQUARE
(125mm x 16 Sq)

Centre punch at
2" (50mm)
from one end

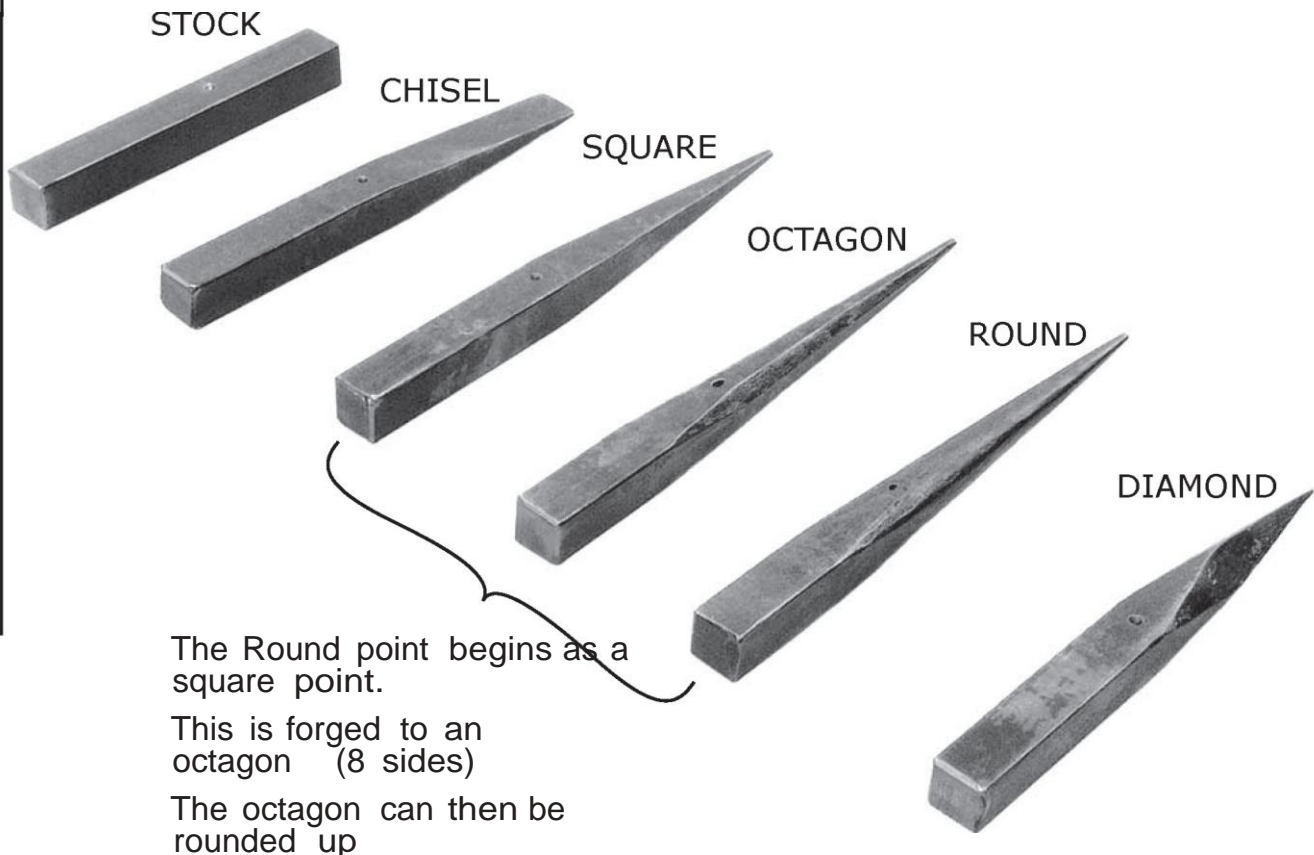
OBJECT:

Developing the skills of forging to section from exercises 1 & 2, you will now forge the basic point forms, . Chisel, Square, Round and Diamond.

Use a ruler or other straight edge to check the sides of the points are straight.

Make sure the points are centred on the bar when looked at from all four sides

Each point should have a clear transition from the stock size starting at the 2"(50mm) centre punch mark.



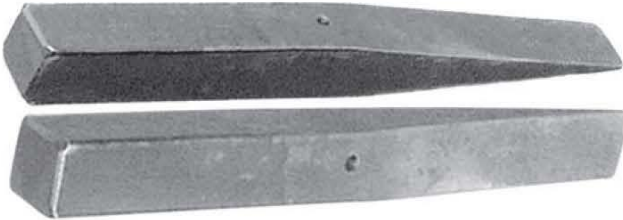
MANDATORY EXERCISE 2 - continued

FORGING POINTS - CHISEL, SQUARE, ROUND, DIAMOND

PLEASE NOTE:

Points and tapers of most kinds can be forged starting at the mark and forging to the end but this requires a very good eye. You may find that forging the point down almost to the finished size, then forging from the mark to the point may be a more reliable method

CHISEL



There should be a clean even taper top and bottom, which is centred on the bar. The sides should be parallel and straight. The 5/8" (16mm) width must be kept all the way to the point.

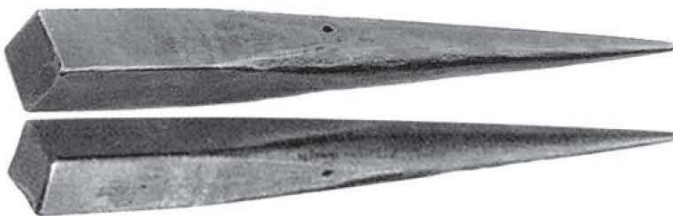
SQUARE

The Square point must be even on all four sides. When forging, keep turning and work all sides evenly. A crisp transition at the punch mark is required.



The OCTAGON is the mid point between Square and round. It is VERY important to make sure that ALL the sides are the same width. If not, it will not be a true octagon and it will be difficult to make a good round section. Notice that the transition point at the punch mark is where the section is a TRUE octagon, not just a square with the corners knocked off

ROUND



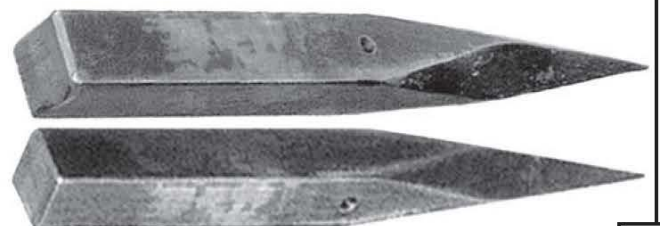
After forging the Octagon and straightening, lightly forge in the remaining corners. Then begin to round up with light blows at a finishing heat while slowly turning the bar under the hammer. It should be fully round at the mark

DIAMOND

With the Diamond point the stock is held on the diagonal.

When forging, make sure that the corner facing you is DEAD CENTRE and that you strike it squarely or it will twist. Work all four sides evenly.

Note that the back point of the diamond (the transition point), is level with the punch mark



MANDATORY EXERCISE 3

STAPLE - FLAT

STOCK:

7" OF 5/8" X 1/4" FLAT
(175mm X 16 X 5mm)



↑
Mark at centre

OBJECT:

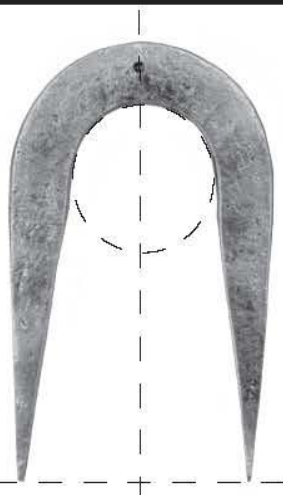
To produce a level, well balanced staple with square points.
The outside edges of the legs should be parallel.
The bend should be even about the centre mark.
There should be no loss of thickness of section towards the points.



Take an even heat about the centre mark and bend to a right angle.



Take a heat on each end in turn and draw out a square point.
Each taper should be of equal length.
The outside edges should be straight.



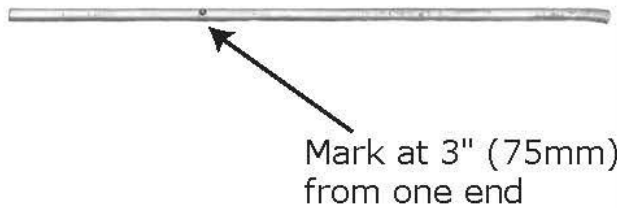
Take an even heat on the middle section and bend around until the legs are parallel.

The points should be in line and the bend should be even about the centre

MANDATORY EXERCISE 4 UNWELDED EYE - ROUND

STOCK:

9" OF 1/4" or 5/16" ROUND
(225mm OF 6mm or 8mm)



OBJECT:

To form a clean circular eye, centred on the bar.

When finished, the eye must be circular and level. There should be little evidence of hammer marks or distortion of the section.



Take a yellow heat at the mark. Quench either side and bend almost to 90°. Straighten either side and make sure the piece is flat.



Take a short yellow heat on the end. Quickly bend the end over the tip of the hook, being careful not to squash the section. Flatten, but keep the round section. Don't hit it too hard or too hot.



Another yellow heat. This time just in front of the mark. Quench the first bend to stop it opening up as you quickly bend over the hook.

NOTE:

Steps 2 and 3 could be reversed. The important thing is to make the difficult bends either end of the eye before closing up. Be sure not to put flats on the round section.



Take an even orange heat between the last two bends. Quench bend No. 1 if necessary, then close up the eye. Make sure the piece is flat and that the eye is circular and centred on the bar. The material should still be round in section.

MANDATORY EXERCISE 5

FLAT RING

STOCK:

11" of 3/4" X 1/4" FLAT
(280mm of 20mm X 6mm)



OBJECT:

To bend a ring on edge from flat bar by eye.

The ring must be circular, level and be free from major hammer marks.

NOTE:

Take care not to reduce the section.



Take a short heat and back up the end to form an angle.
One edge will be around 1/4" (6mm) shorter than the other.
Repeat on other end



Take a heat on about a quarter of the length
and bend over the Bick.

Note which side the angle on the end is.

Flatten and straighten.



Repeat the last step on the other end.



Finally, take an EVEN heat over the centre section and
bring the two ends around until they meet.

Flatten and round up the circle.

The use of a mandrel for rounding is not permitted.

MANDATORY EXERCISE 6

FIGURE OF EIGHT - ROUND

STOCK:

8" OF 1/4" OR 5/16" ROUND
(200mm OF 6mm OR 8mm)



Mark at centre

OBJECT:

To forge a shape using the Bick of the anvil to form two connected circles.

This to be done without flattening or mutilating the round section.

The final piece is to be symmetrical, level and clean.



Take a **SHORT** yellow heat on the end of the bar and quickly turn it over the bick.

Straighten any distortion in the rest of the bar.



Take another yellow heat around the mark.

Quench just short of the mark as well as the first bend and turn the second bend.

NOTE: Steps 1 & 2 could be reversed



Take an even heat between the two bends and almost complete the circle.

Leave it a little open for now.

Straighten and level.



Repeat step 1 on the other end of the bar.



Repeat step 2.

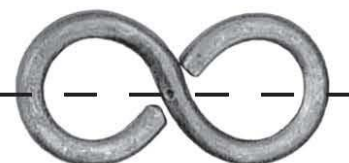
You must have a good heat and work quickly in order to form the bend cleanly without any straight section near the mark.



Repeat step 3.

Note that the ends are not yet closed in. This is to allow a degree of access to refine the shape if necessary.

Level if distorted. Don't flatten the section.



Finally, take a heat and close in the ends which should meet at the centre mark.

If you have difficulty in refining the shape on the ends, twist them to the sides to enable you to get at them with the hammer.

Level up

MANDATORY EXERCISE 7

SET EYE HOOK

STOCK:

7 3/4" OF 3/4" X 1/4" FLAT
(195mm of 20mm X 6mm)



OBJECT:

To produce a flat hook with an unwelded, forged eye.

The hook should be of clean finish and hang centrally from the eye, (see final step).

From the 2 3/4" (70mm) mark, draw an even, straight taper 4 1/4" (106mm) long



Turn the piece around and set down at the 1 1/2" (38mm) mark.
Draw it out to 3/8" (10mm) square. It should be about 2" (50mm) long.
Make sure the section is parallel and not tapering.



Forge the square section into an octagon.
If the end is becoming smaller in section, upset it and square up the end.



Round up the section. Straighten and true up.
By now it should be approximately 2 1/2" (63mm) long

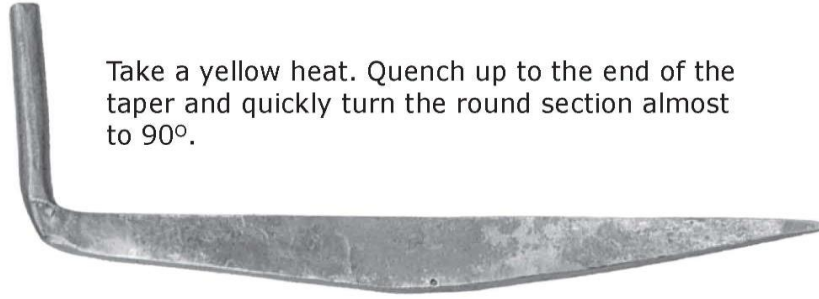


Draw a taper behind the round section. The taper should be 4 1/4" (106mm) long.
Straighten and true up.

NOTE:- Make sure that the set remains well defined as a step



MANDATORY EXERCISE 7 - continued SET EYE HOOK



Take a yellow heat. Quench up to the end of the taper and quickly turn the round section almost to 90°.



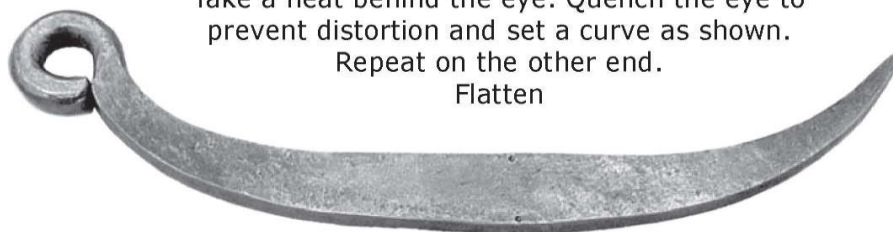
Take another heat. Quench up to the bend to chill it and quickly knock the end over.



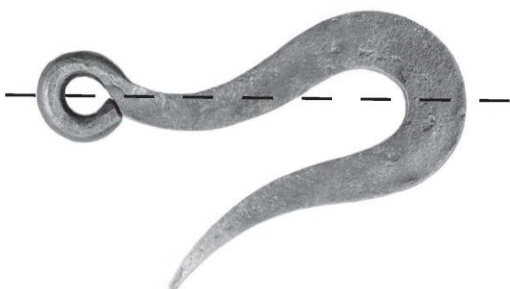
Take a SHORT yellow heat and set the curve right up to the tip.



Take an even orange heat to complete the eye. See that it is centralised.



Take a heat behind the eye. Quench the eye to prevent distortion and set a curve as shown. Repeat on the other end.
Flatten



Take an even orange heat in the central section and bend in the opposite direction over the Bick.

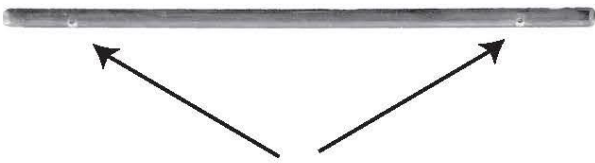
Flatten and align as necessary so that when hung from the eye, a line can be drawn vertically through the centre of the bend.

MANDATORY EXERCISE 8

BOW SHACKLE - LARGE - SET EYE

STOCK:

12" OF 3/8" ROUND
(300mm OF 10mm)



Mark at 1 1/2" (38mm) from each end

OBJECT:

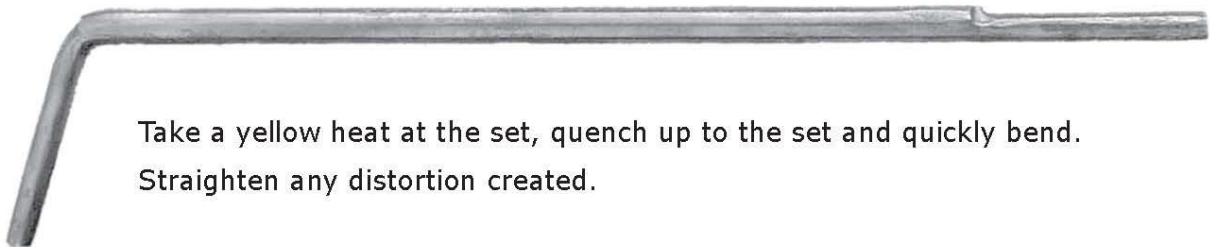
To set down a section, round up and form an eye on each end of a bar.

To shape the bar into a well balanced, circular form with the eyes parallel and spaced 3/4" (20mm) apart.

The whole to be clean, level and without loss of the round section.



Take a heat on one end and set down on two sides only.
Forge to a 5/16" (8-9mm) square section 2" (50mm) long.
Forge this to an octagonal section and round up, by which time it should be approximately 2 1/4" (55mm) long.
Repeat on the other end. Both ends must be the same length and section.



Take a yellow heat at the set, quench up to the set and quickly bend.
Straighten any distortion created.



Form the eye as in previous exercises.
Repeat on the other end.
Straighten up.



Crank one of the eyes over to about 45° and repeat on the other end.
Straighten up again and see that the eyes are in line and not twisted.

It is very important that the bar between the eyes is perfectly straight or a smooth bend will be very difficult to achieve.



Take a heat on about a quarter of the length, quench the eye to prevent distortion and bend over the bick.
Repeat on the other end.

Finally, take an EVEN heat over the central section, chill the ends if necessary and complete the bend.

See that the form is **circular** and that the eyes are properly aligned, not twisted and 3/4" (20mm) apart.

MANDATORY EXERCISE 9 TIE BAR

STOCK:

8" OF 5/8" SQUARE
(200mm OF 16mm)



Mark at 2" (50mm) from one end

OBJECT:

By upsetting, to form a circular eye.
A ring may then be connected.

To split and open the bar to provide a
balanced, ragged end to fix.

The whole must be level. The eye is
to be central and the bar split evenly
down the centre.



Take a short **yellow** heat up to the
mark. If necessary, quench to just
short of the mark.

Upset the end. Each heat should be
to the same point to produce the
shoulder.

The final upset should be 1" (25mm)
square and slightly thicker than the
bar.

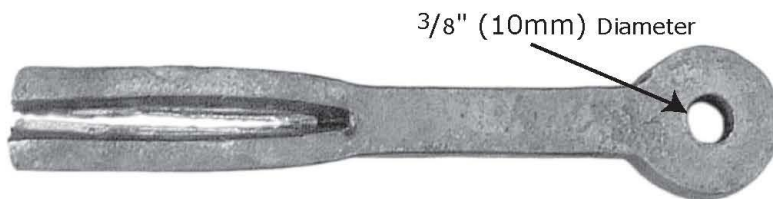


Forge the corners of the square to
produce an octagon



Forge in the corners. Then round
up the shape

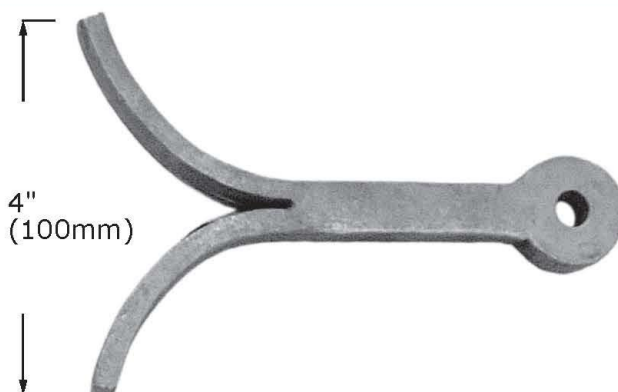
Punch a hole in the centre and drift
out to 3/8" (10mm).



3/8" (10mm) Diameter

Mark 3" (75mm) from the other end
and using a hot chisel, split one
side to the centre.

Then cut from the other side to the
centre, parting the two halves.



Open out the split ends.

Hot rasp off ripped edges if present and
LIGHTLY forge in the section.

Set a balanced curve on each leg leaving
the ends 4" (100mm) apart.

The whole piece should retain a clean finish
and be level.

MANDATORY EXERCISE 10 SMALL FLAT BIT TONGS

STOCK:

8" OF 5/8" SQUARE
(200mm of 16mmSq)
(Two pieces)



Mark at 1 3/8" (35mm) FROM END

OBJECT:

To produce a pair of small flat bit tongs with a clean finish.

NOTE:

Two pieces are necessary.
At each step, make sure both pieces are matched.



Set down at the mark.

Do not forge the width back to 5/8" (16mm) or when finished, it will be undersize. Better larger than smaller as you will come back to finish the jaw & hinge area later. The dimensions of the jaw at this stage should be approximately 2" X 5/16" X 7/8" (50 X 8 X 22mm).



Turn 90° to the left and set down at 45°. Make sure the set lines up with the corner of the first set.

Again, **allow the metal to spread**. Forge to approx 5/16" X 7/8" (8mm X 22mm). True up.



Turn 90° to the left again and set down at around 1 1/2" (38-40mm) from the first set. Set down only about a third of the width. **REMEMBER, THIS IS THE POINT WHICH NEEDS MAXIMUM STRENGTH**. It is as thick as the hinge plate and two thirds as high.



Draw out the rein. There should be enough material to draw to 12" (300mm). The size at the end should be about 5/16" X 1/4" (8mm X 6mm) and the taper between the last set and the end should be straight and clean. **DO NOT** reduce the section behind the hinge plate.



From just behind the hinge plate, knock off the corners. use gentle blows to start, becoming a little heavier as you work towards the end.
True up the rein.

MANDATORY EXERCISE 10 - continued

SMALL FLAT BIT TONGS



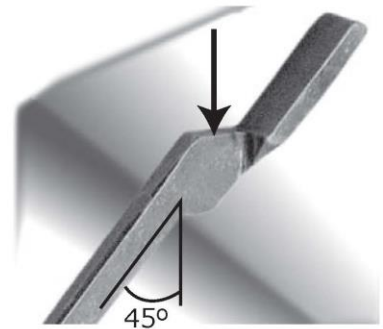
Having knocked the corners off, now round up the top and bottom of the rein.



Then tip the end down **a little**. this will help prevent the tongs slipping in the hand and to locate a ring if needed.
True up.



Take a heat on the hinge area and resting the set at 45° on the anvil, strike the upper edge to set the angles. Flatten with the set side down on the anvil. Repeat if necessary.
Note that this shortens and broadens the hinge.
True up.



At a bright orange/yellow heat, take a short scrap piece of 1/4" (6mm) round and hold it in the centre of the jaw. Get an assistant to hammer it in. **MAKE SURE** it is central before you go too far.
Do the same thing at right angles to the first one.
This will make the tongs more useful as they will also be able to hold small rounds and squares



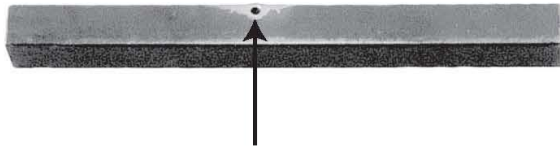
Punch a 3/8" (10mm) hole in the centre of the hinge plate. Flatten out any distortion and drift the hole to its true size.
If the hinge plates are slightly different sizes, punch the smaller one first and use this to mark the other from.
Rivet up and set the jaws using a scrap piece of 1/4" (6mm) flat between them.
Set the reins to a comfortable size.

OPTIONAL EXERCISE 1

FORGING TO SECTION - SET DOWN SECTIONS

STOCK:

7" of 5/8" SQUARE
(180mm of 16mm Sq)



Mark at 3" (75mm) from end

OBJECT:

To forge to controlled sections by setting down and drawing out.

The sections are to be as free of hammer marks as possible, to be parallel and to have a clean finish.



Set down from the 3" (75mm) mark and draw out the remainder to 5/8" X 5/16" (16mm X 8mm).

Square off the end and make sure the bar is straight & true. Mark at 1 1/2" (38mm) from the set.



Set down from the mark and draw out the remainder to 5/16" X 5/16" (8mm X 8mm).

Straighten and mark at 2" (50mm) from the last set.



From the mark, knock off the corners to produce a true octagonal (8 sided) section.

Check that all 8 sides are the same width.

Straighten and mark at the mid point of the octagonal section.



From this point knock the corners off the octagon working up and down the length, then work off any remaining corners.

Round up at a finishing heat with light blows while slowly rotating the bar.

OPTIONAL EXERCISE 2 STAPLE - ROUND

STOCK:

6" OF 3/8" ROUND
(150mm OF 8mm)



↑
Mark at centre

OBJECT:

To produce a well balanced staple with chisel points.

The points should be in line and the outside edges of the legs should be parallel.

The piece should be clean with no distortion of the round section.



Take an even heat about the centre mark and bend to a right angle.

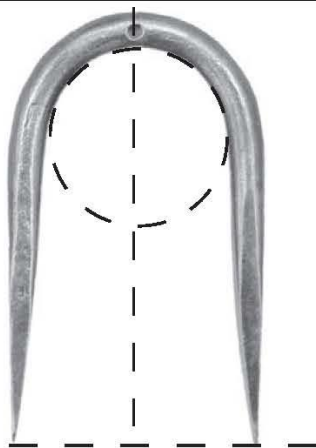


Take a heat on each end in turn and draw out a chisel point.

Each taper should be of equal length, **about half the length of the leg.**

The outside edges should be straight and parallel.

Looked at from the side, the section should not reduce.



Take an even heat on the middle section and bend around until the legs are parallel.

The points should be in line and the bend should be even about the centre

O-2

OPTIONAL EXERCISE 3 UNWELDED EYE - FLAT

STOCK:

10" OF 5/8" X 1/4" FLAT
(250mm OF 16 X 5mm)



Mark at 3" (75mm)
from one end

OBJECT:

To form a clean circular eye, centred on the bar.

When finished, the eye must be circular and level.
There should be little evidence of hammer marks.



Take a yellow heat at the mark. Quench either side and bend almost to 90°. Straighten either side and make sure the piece is level.



Take a short yellow heat on the end. Quickly bend the end over the tip of the hook, being careful not to reduce the width.



Another yellow heat. This time just in front of the mark. Quench the first bend to stop it opening up as you quickly bend over the hook.

NOTE:

Steps 2 and 3 could be reversed. The important thing is to make the difficult bends either end of the eye before closing up



Take an even orange heat between the last two bends. Quench bend No. 1 if necessary, then close up the eye. Make sure the piece is level and that the eye is circular and centred on the bar.

OPTIONAL EXERCISE 4
FIGURE OF EIGHT - FLAT

STOCK:

11" OF 5/8" X 1/4" FLAT
(280mm OF 16 X 5mm)









Mark at centre

OBJECT:

To forge a shape using the Bick of the Anvil to form two connected circles.

This to be done without reducing the width or thickness of the flat section.

The final piece is to be symmetrical, level and clean.

 <p>Take a SHORT yellow heat on the end of the bar and quickly turn it over the bick.</p> <p>Straighten any distortion in the rest of the bar.</p> <p>Do not reduce the width.</p>	 <p>Take another yellow heat around the mark.</p> <p>Quench just short of the mark as well as the first bend and turn the second bend.</p> <p>NOTE: Steps 1 & 2 could be reversed</p>	 <p>Take an even heat between the two bends and almost complete the circle.</p> <p>Leave it a little open for now.</p> <p>Straighten and level.</p>
 <p>Repeat step 1 on the other end of the bar.</p>	 <p>Repeat step 2.</p> <p>You must have a good heat and work quickly in order to form the bend cleanly without any straight section near the mark.</p>	 <p>Take a heat between the two bends and close up the second half.</p> <p>Adjust so that the centre of each end lines up with the punch mark.</p>

OPTIONAL EXERCISE 5

BOW SHACKLE - SMALL - TURNED EYE

STOCK:

10" OF 1/4" ROUND
(250mm OF 6mm)



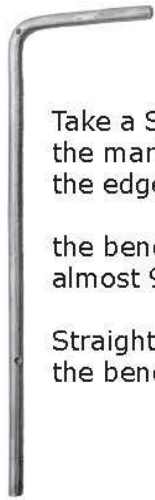
Mark at 2 1/4" (55mm) from ends

OBJECT:

To form an eye on each end of a bar.

To shape the bar into a well balanced circular form with the eyes parallel and spaced 3/4" (20mm) apart.

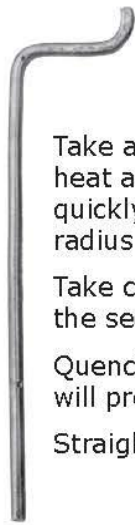
The whole to be clean, level and without loss of the round section.



Take a SHORT heat about the mark and bend over the edge of the anvil.

the bend should be almost 90°.

Straighten either side of the bend.



Take a SHORT yellow heat at the tip and quickly bend it to the radius of the finished eye.

Take care not to squash the section at the tip.

Quenching the first bend will prevent distortion
Straighten.



Take another short heat ahead of the first bend.

Quench just up to the first bend and knock forwards.



Close up the eye.

The eye should be as circular as possible and centred on the bar.



Repeat on the other end.

Keep the bar straight and the eyes centred.



Crank the eyes over to approximately 45°.

See that they are not twisted and are still centred

Take a long even heat.

Quench the eyes and bend around.



True up and align the eyes.

The eyes should be 3/4" (20mm) apart.

OPTIONAL EXERCISE 6

HEART - UPSET RIGHT ANGLE BEND

STOCK:
8" OF 1/2" SQUARE
(200mm OF 12mm)



↑
Mark at centre

OBJECT:

To forge a right angle bend by upsetting.

Then, by drawing down and controlled bending with the hammer, to produce a clean, level and balanced heart



Take a SHORT heat in the centre of the bar.

It may help to quench either side of the punch mark.

Bend the piece but DO NOT bring it to 90°.

The punch mark should be in the centre of the bend.



Again, using short heats, work each arm in turn, upsetting into the bend.

Keep the mark in the centre of the bend.

As the work progresses, the angle of the bend should become tighter but at this stage, still not quite 90°.

Maintain a small radius on the inside of the bend.



Continue working up the bend by upsetting the arms into it and also using the hammer on the outside faces to produce a crisp, sharp corner.

Notice the punch mark is still in the centre.



Starting almost in the corner, draw out each arm to an even taper of equal lengths.

Chill the bend or it will distort during this process.

The outer edges should be at right angles to each other.



Scroll the two ends using hammer only.

Keep checking to see that they are balanced.



Finally, bring the two arms together.

Chill the bend to prevent distortion.

Be sure to take EVEN heats and keep checking for balance



Appendix 3 Sources of general information.

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on www.cityandguilds.com.

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information such on such things as:

- **Walled Garden:** how to register and certificate candidates on line
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for GOLA/e-volve assessments.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve ‘approved centre’ status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

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Useful contacts

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International learners General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: intcg@cityandguilds.com
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: centresupport@cityandguilds.com
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: singlesubjects@cityandguilds.com
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: intops@cityandguilds.com
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: walledgarden@cityandguilds.com
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: business@cityandguilds.com
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