Pearson BTEC Level 3 Nationals Extended Certificate

Set Task Release Date: 29/04/2019

Paper Reference **31708H**

Engineering

Unit 3: Engineering Product Design and Manufacture

Part A

You do not need any other materials.

Instructions

- **Part A** contains material for the completion of the preparatory work for the set task.
- **Part A** should be undertaken over no more than 3 hours in a period of 1 week as timetabled by Pearson.
- **Part A** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part B** materials must be issued to learners during the period specified by Pearson.
- This **Part A** task booklet must not be returned to Pearson.

Information

- In **Part B**, the task should be undertaken in 8 hours under supervision over no more than 5 consecutive working days. The supervised sessions take place in the two-week period timetabled by Pearson.

Turn over ▶

W61580A

1/1/1

W 6 1 5 8 0 A

Pearson

Instructions to teachers

This paper must be read in conjunction with information on conduct for the task in the unit specification and the BTEC Nationals Instructions for Conducting External Assessments (ICEA) document. For further details please see the Pearson website.

Part A should be issued to learners one week prior to undertaking **Part B** of the assessment.

Learners will be expected to conduct research.

Research is expected to be carried out over 3 hours. Centres must advise learners of the timetabled sessions during which they can carry out the research. It is expected that scheduled lessons or other timetable slots will be used for some or all of this work.

Learners can produce individually prepared research notes (maximum of two sides of A4) to take into the **Part B** supervised assessment.

Teachers cannot give any support to the production of the notes and the work must be completed independently by the learner.

For **Part B**, centres are free to arrange the supervised assessment period how they wish provided the 8 hours for producing final outcomes are completed over no more than 5 consecutive working days, are under the level of supervision specified and in accordance with the conduct procedures.

Refer carefully to the instructions in this task booklet and the Instructions for Conducting External Assessments (ICEA) document to ensure that the preparatory period is conducted correctly and that learners have the opportunity to carry out the required activities independently.

Learner research notes will be retained securely by the centre after **Part B** and may be requested by Pearson if there is suspected malpractice.

Instructions for Learners

Read the set task information carefully.

This contains **Part A**, which is the information you need to prepare for the set task.

You will need to carry out your own research over the next week and you can take up to two A4 sides of individually prepared research notes into **Part B** of the set task.

You will then be given the set task to complete under supervised conditions.

For **Part A**, you must work independently and must not share your work with other learners.

Your teacher will give guidance on when the preparation should be completed.

Your teacher cannot give you feedback during the preparation period.

Set Task Brief

You are advised to spend a maximum of three hours doing your research.

You work for a large multinational manufacturing company as a junior production engineer. Your manager has asked you to redesign a clamping solution as it is not working effectively. The clamping solution holds a pneumatic cylinder. The pneumatic system is used to divert boxes from one conveyor to a table, as part of a production line.

The redesigned solution must be manufactured several times for different production lines.

You will research the design and manufacturing requirements that are relevant to the clamping solution and its use. Your research should consider:

- existing design of clamps, which could be bought-in items, and the function of pneumatic cylinders
- the health and safety requirements for making and using clamping solutions
- environmental considerations including sustainability
- material requirements and suitable material properties
- the manufacturing processes that are used to make and assemble a small batch of clamping solutions using some bought-in items
- any other relevant factors, such as removal and replacement of the pneumatic cylinder.

In **Part B** you will be given further information on the specific issues with the existing clamping solution that will allow you to redesign the solution and evaluate it against the issues. Therefore, you are advised not to undertake any design work during **Part A** (the research stage).

You will be able to take up to two sides of individually prepared A4 research notes from **Part A** into **Part B** of the set task.

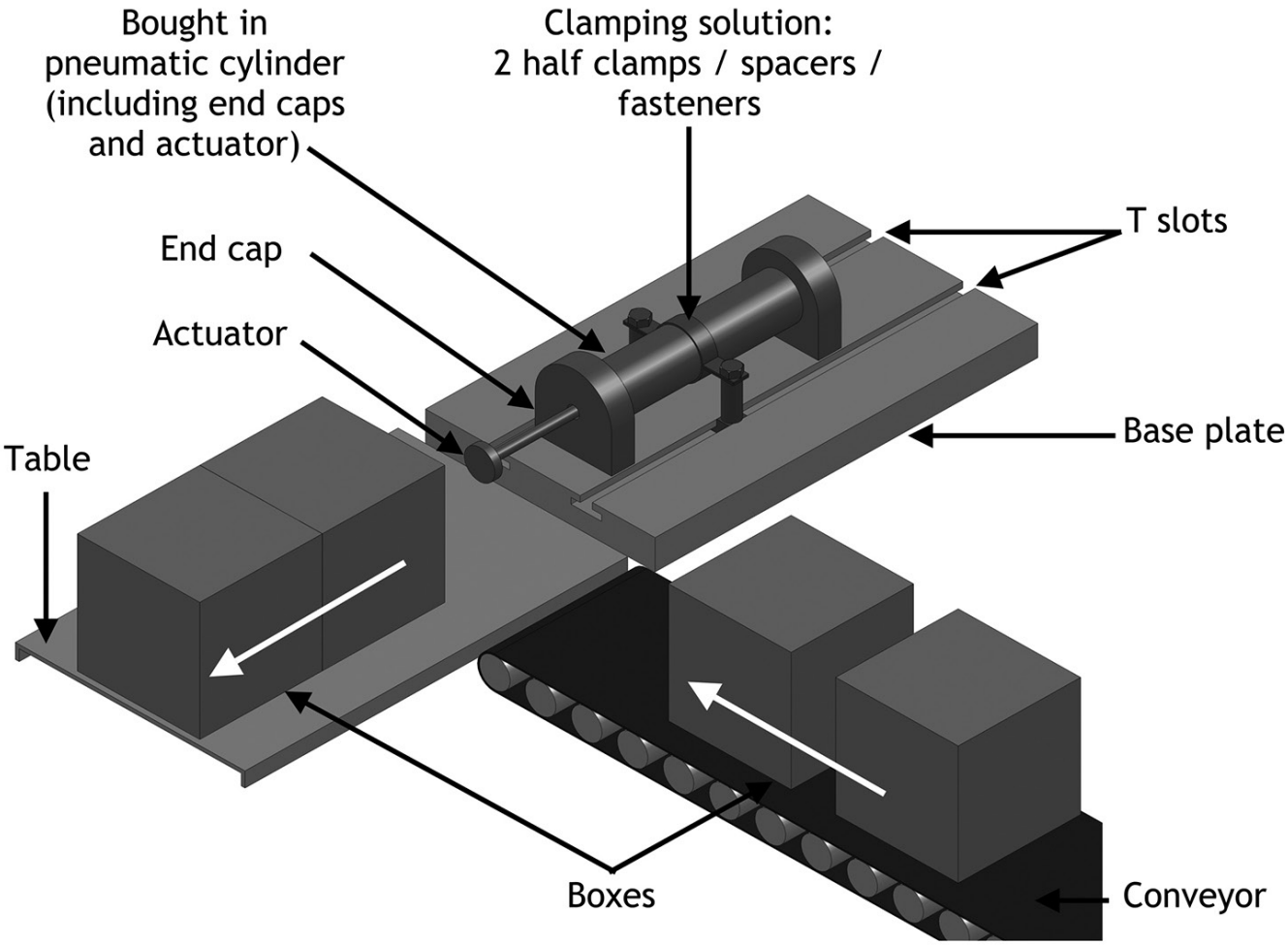
Part A Set Task Information

The redesign is for a clamping solution to hold a pneumatic cylinder in position. The actuator moves in a linear direction, forwards and backwards, to push each box sideways. The pneumatic cylinder is clamped onto a base plate that contains t-slots.

The pneumatic cylinder is a bought-in item (including both end-caps and actuator) and it is currently secured to the base plate by two half clamps and spacers with associated fasteners.

The redesigned solution must be manufactured several times for different production lines.

Pneumatic System



Size of base plate: Thickness – 20mm; Length – 250mm; Width – 150mm
Material: Aluminium

Pearson BTEC Level 3 Nationals Extended Certificate

Window for Supervised Period:
07/05/2019 to 21/05/2019

Controlled hours: 8 hours | Paper Reference **31708H**

Engineering

Unit 3: Engineering Product Design and Manufacture

Part B

Information booklet

Do not return this Information Booklet with the question paper.

Instructions

- You will need the information in this booklet to complete the task.
- Read the information carefully.
- You must **not** write your answers in this booklet.
- Only your answers given in the task booklet in **Part B** will be marked.

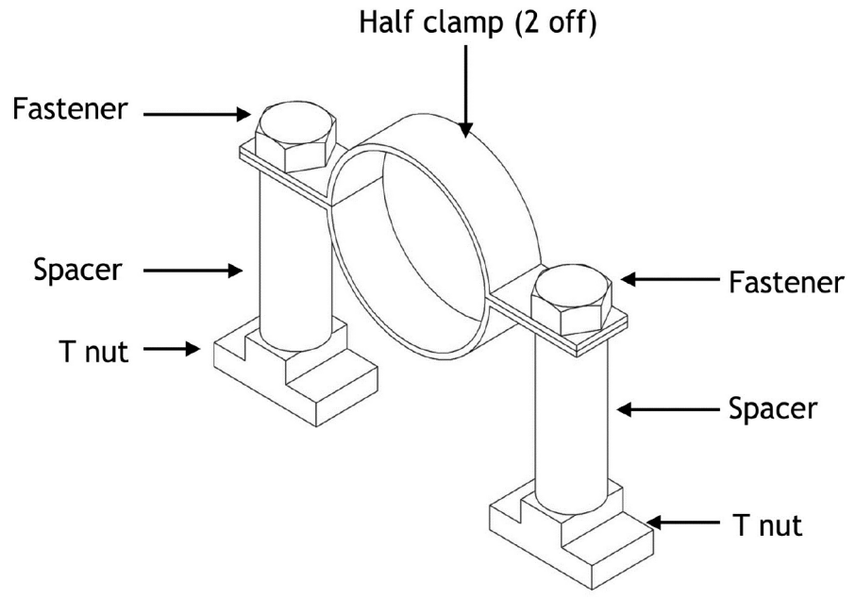
Turn over ▶

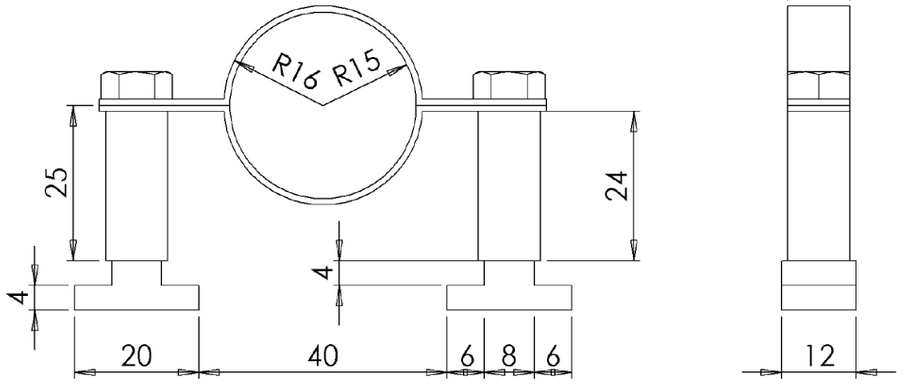
P60374A

1/1/1/1

P 6 0 3 7 4 A

Pearson





UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING — REVISION 3.1

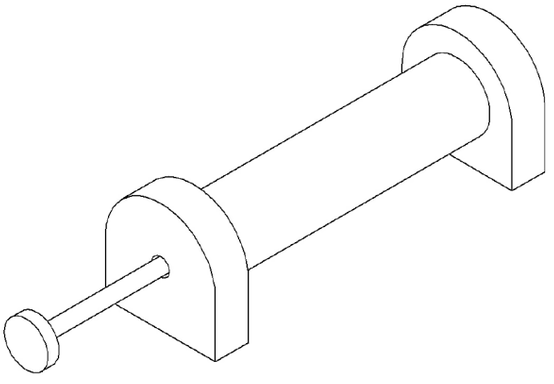
	NAME	SIGNATURE	DATE
DRAWN	W. BONDS	*B Bonds*	3/2/19
CHK'D	T. BROOKING	*T Brooking*	4/2/19
APPV'D	J. LYLE	*J Lyle*	5/2/19

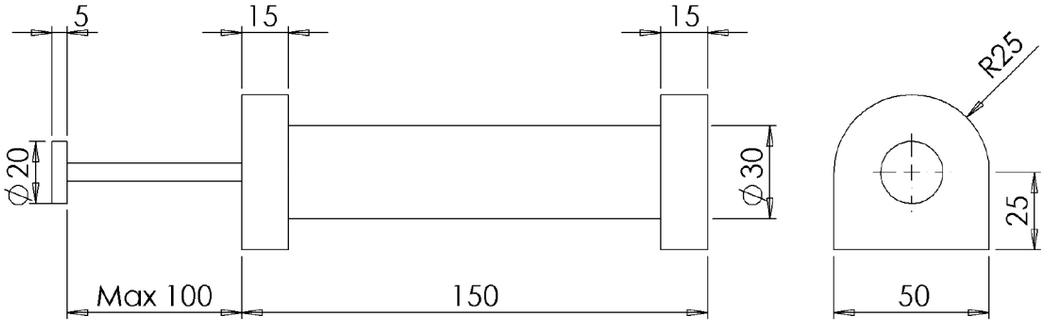
TITLE: CLAMPING SOLUTION

MATERIAL: ALUMINIUM

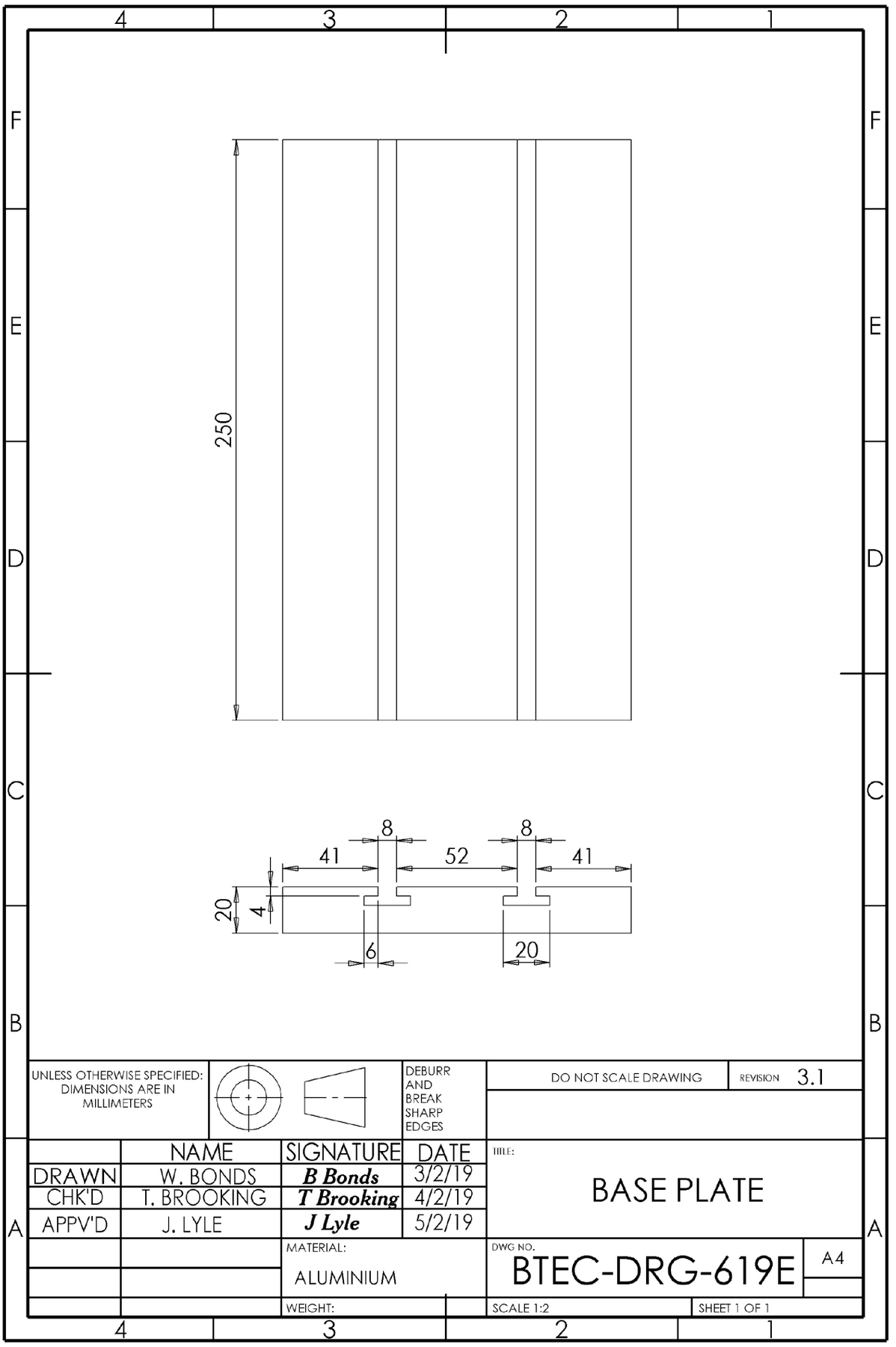
DWG NO. BTEC-DRG-619D — A4

WEIGHT: — SCALE 1:2 — SHEET 1 OF 1





UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING — REVISION 3.1
	NAME	SIGNATURE	DATE	TITLE: PNEUMATIC CYLINDER
DRAWN	W. BONDS	*B Bonds*	3/2/19	
CHK'D	T. BROOKING	*T Brooking*	4/2/19	
APPV'D	J. LYLE	*J Lyle*	5/2/19	
		MATERIAL: ALUMINIUM		DWG NO. BTEC-DRG-619C — A4
		WEIGHT:		SCALE 1:2 — SHEET 1 OF 1


4
3
2
1
F
E
D
C
B
A
250
8
8
41
52
41
20
4
6
20
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN
MILLIMETERS
DEBURR
AND
BREAK
SHARP
EDGES
DO NOT SCALE DRAWING
REVISION 3.1
NAME
SIGNATURE
DATE
DRAWN
W. BONDS
B Bonds
3/2/19
CHK'D
T. BROOKING
T Brooking
4/2/19
APPV'D
J. LYLE
J Lyle
5/2/19
TITLE:
BASE PLATE
MATERIAL:
ALUMINIUM
DWG NO.
BTEC-DRG-619E
A4
WEIGHT:
SCALE 1:2
SHEET 1 OF 1

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate

Centre Number | | | | | | |

Learner Registration Number | | | | | | | | |

Window for Supervised Period:
Tuesday 7 May 2019 to Tuesday 21 May 2019

Controlled hours: 8 hours

Paper Reference **31708H**

Engineering

Unit 3: Engineering Product Design and Manufacture

Part B

You must have:
Information Booklet containing engineering drawings (enclosed), HB or B pencil, ruler, eraser, drawing instruments and calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- You will need your research notes from **Part A** (maximum two A4 sides).
- **Part B** should be undertaken in 8 hours under supervision over no more than 5 consecutive working days. The supervised sessions take place in the two-week period timetabled by Pearson.
- **Part B** contains material for the completion of the set task under supervised conditions.
- **Part B** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part B** should be kept securely until the start of the 8-hour supervised assessment period.
- You must not submit your research notes to Pearson.
- Answer **all** activities.
- Answer the activities in the spaces provided
  – there may be more space than you need.

Information

- The total mark for this paper is 60.
- The marks for **each** activity are shown in brackets
  – use this as a guide as to how much time to spend on each activity.

Advice

- Read each activity carefully before you start to answer it.
- Try to answer every activity.
- Check your answers if you have time at the end.

Turn over ▶

P60374A

1/1/1/1

P 6 0 3 7 4 A 0 1 3 6

Pearson

Instructions to Teachers and/or Invigilators

This paper must be read in conjunction with information on conduct for the task in the unit specification and the BTEC Nationals Instructions for Conducting External Assessments (ICEA) document. For further details please see the Pearson website.

The set task should be carried out under supervised conditions.

Work should be completed in this task booklet, using additional sheets if required.

Learners can use individually prepared research notes (maximum two sides of A4) to support the supervised assessment **(Part B)**. These research notes must be kept secure once the supervised assessment has begun.

All learner work must be completed independently and authenticated before being submitted to Pearson by the teacher and/or invigilator.

Centres are free to arrange the supervised assessment period how they wish, provided the 8 hours for producing final outcomes are under the level of supervision specified, and in accordance with the conduct procedures. The assessment must take place in a two week period set by Pearson, once the learner has started **Part B** the assessment must be completed in 5 consecutive working days.

Refer carefully to the instructions in this task booklet and the Instructions for Conducting External Assessments (ICEA) document to ensure that the assessment is supervised correctly. An authentication statement will be required confirming that learner work has been completed as directed.

Learners must not bring anything into the supervised environment or take anything out without your knowledge and approval.

Centres are responsible for putting in place appropriate checks to ensure that only permitted material is introduced into the supervised environment.

Maintaining security

- For **Part B**, learners **must not** have access to computers or the internet.
- Learners can only access their work under supervision.
- Any work learners produce under supervision must be kept secure.
- Any materials being used by learners must be collected in at the end of each session, stored securely and handed back at the beginning of the next session.

Outcomes for Submission

One task booklet will need to be submitted by each learner, which includes the following tasks:

- the project planning and product design changes made during the development process
- interpretation of the brief into operational requirements
- a range of (three or four) initial design ideas based on the client brief
- a modified product proposal with relevant design documentation
- an evaluation of the design proposal
- a fully completed authentication sheet must be completed by each learner.

Learner research notes will be retained securely by the centre after **Part B** and may be requested by Pearson if there is suspected malpractice.

Instructions for learners

Read the set task information carefully.

You must plan your time accordingly and be prepared to submit all the required evidence by the date specified.

You may use your preparatory work from **Part A** to complete the set task in **Part B**.

Your preparatory notes from Part A will not be submitted with the task booklet from Part B. Only your task booklet from Part B will be submitted to Pearson for marking.

You will complete this set task under supervision and your work will be kept securely during any breaks taken.

For **Part B**, you **must not** use computers or the internet.

You must work independently throughout the supervised assessment period and must not share your work with other learners.

In the information booklet you will be provided with drawings of the pneumatic cylinder and the clamping solution for the pneumatic cylinder.

Outcomes for submission

You will need to submit one task booklet on completion of the supervised assessment period, which includes the following activities:

- a record of the project planning and product design changes made during the development process
- interpretation of the brief into operational requirements
- a range of (three or four) initial design ideas based on the client brief
- a modified product proposal with relevant design documentation
- an evaluation of the design proposal.

A fully completed authentication sheet must also be submitted; any prepared research notes must not be submitted with the final outcomes to Pearson.

Part A Set Task Brief

You work for a large multinational manufacturing company as a junior production engineer. Your manager has asked you to redesign a clamping solution as it is not working effectively. The clamping solution holds a pneumatic cylinder. The pneumatic system is used to divert boxes from one conveyor to a table, as part of a production line.

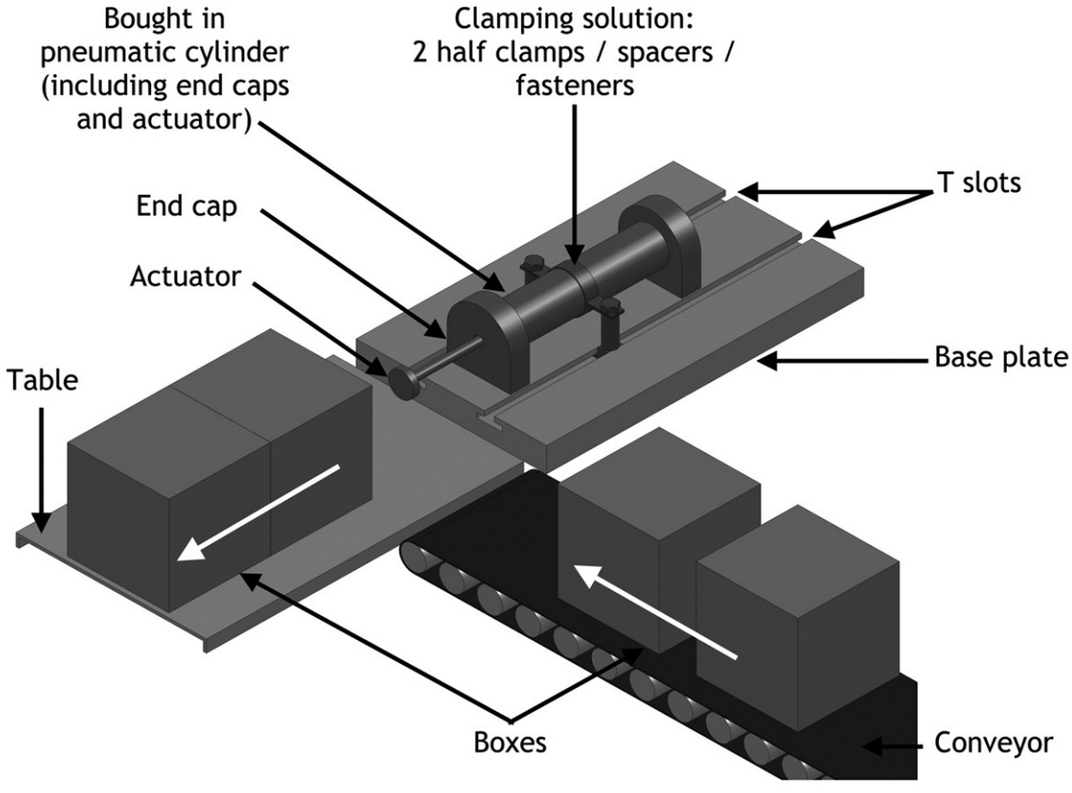
Part A Set Task Brief Information

The redesign is for a clamping solution to hold a pneumatic cylinder in position. The actuator moves in a linear direction, forwards and backwards, to push each box sideways. The pneumatic cylinder is clamped onto a base plate that contains t-slots.

The pneumatic cylinder is a bought-in item (including both end-caps and actuator) and it is currently secured to the base plate by two half clamps and spacers with associated fasteners.

The redesigned solution must be manufactured several times for different production lines.

Pneumatic System



Size of base plate: Thickness – 20mm; Length – 250mm; Width – 150mm
Material: Aluminium

Part B Set Task Information

For **Part B**, you are allowed to use your individually prepared research notes from **Part A** to support you during the supervised assessment period.

In the information booklet you will be provided with drawings of the pneumatic cylinder and the clamping solution for the pneumatic cylinder.

Client brief

A large multinational manufacturing company is aware that a pneumatic system on a production line has many issues, but the redesign has been triggered by comments from operatives about the amount of non-productive time resulting from these issues. Operatives' feedback is that the pneumatic system is not effective for several reasons.

The company believes that the source of the issues are problems with the unintended movement of the pneumatic cylinder, which results in the actuator not diverting the box from the conveyor to the table correctly. Specifically, there is linear movement backwards and angular movement from the clamping solution rotating/twisting on the base plate. The company has said that redesign of the pneumatic cylinder (which includes the end-caps and actuator) is not possible, as it is a bought-in item. Modifications to the existing base plate, as part of the clamping solution, are possible. No other modifications can be made to the production line.

Based on testing, the company has provided the following information in Table 1, which can be used to carry out a statistical analysis of the unintended movement of the pneumatic cylinder.

The company needs you to design a solution that will prevent the unintended movement of the pneumatic cylinder.

Your solution must take into account the most efficient use of materials as well as safety, form, sustainability and other factors. You also have an opportunity to reduce the issues with the unintended movement of the pneumatic cylinder by considering equipment interfaces, modifying bought-in items and retrofitting other low cost components.

The solution **must**:

- Secure the pneumatic cylinder to the existing base plate
- Allow the pneumatic cylinder to be quickly removed and refitted for maintenance purposes
- Be robust enough to cope with use on a production line
- Ensure that the pneumatic cylinder is always in the correct position to divert the box accurately from the conveyor to the table
- Be able to be manufactured several times for different production lines.

Table 1 – Statistical data of the unintended movement of the bought in pneumatic cylinder

Time elapsed (hours)	Actuator Velocity 50mm/s		Actuator Velocity 36mm/s		Actuator Velocity 30mm/s	
	Linear movement (mm) →	Angular movement/ twisting of clamping solution (degrees) ↻	Linear movement (mm) →	Angular movement/ twisting of clamping solution (degrees) ↻	Linear movement (mm) →	Angular movement/ twisting of clamping solution (degrees) ↻
2	10	11	10	5	6	3
3	14	11	8	6	8	6
4	20	12	17	6	11	4
5	26	13	23	7	15	4
6	32	13	28	7	22	4
7	35	13	33	8	24	5

Redesign of the product

Activity 1

At the start of the task create a short outline project time plan in your task booklet.

During the other activities (2 to 5), you should also record **in the Activity 1 section** of your task booklet:

- why specific changes were made to the design during each session
- specific action points for the next session.

(Total for Activity 1 = 6 marks)

Suggested time 45 minutes

Activity 2

Interpret the client brief into operational requirements, to include:

- product requirements
- opportunities and constraints
- interpretation of numerical data
- key health and safety, regulatory and sustainability factors.

(Total for Activity 2 = 6 marks)

Suggested time 45 minutes

Activity 3

Produce a range of (three or four) initial design ideas based on the client brief, to include:

- sketches
- annotations.

(Total for Activity 3 = 9 marks)

Suggested time 1 hour 15 minutes

Activity 4

Develop a modified product proposal with relevant design documentation.

The proposal **must** include:

- a solution including a final drawing.
- The proposal **must** consider:
  - existing products
  - materials
  - manufacturing processes
  - sustainability
  - safety
  - other relevant factors.

(Total for Activity 4 = 30 marks)

Suggested time 4 hours

Activity 5

Your final task booklet entry **must** evaluate:

- success and limitations of the completed solutions
- indirect benefits and opportunities
- constraints
- opportunities for technology-led modifications.

(Total for Activity 5 = 9 marks)

Suggested time 1 hour 15 minutes

BLANK PAGE

ACTIVITY 1 BEGINS ON THE NEXT PAGE.

Activity 1

At the start of the task create a short outline project time plan in your task booklet.

During the other activities (2 to 5), you should also record **in the Activity 1 section** of your task booklet:

- why specific changes were made to the design during each session
- specific action points for the next session.

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Activity 1 = 6 marks)

Activity 2

Interpret the brief into operational requirements, to include:

- product requirements
- opportunities and constraints
- interpretation of numerical data
- key health and safety, regulatory and sustainability factors.

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Activity 2 = 6 marks)

Activity 3

Produce a range of (three or four) initial design ideas based on the client brief, to include:

- sketches
- annotations.

(9)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Activity 3 = 9 marks)

Activity 4

Develop a modified product proposal with relevant design documentation.

The proposal **must** include:

- a solution including a final drawing.

The proposal **must** consider:

- existing products
- materials
- manufacturing processes
- sustainability
- safety
- other relevant factors.

(30)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Activity 4 = 30 marks)

Activity 5

Your final task booklet entry must evaluate:

- success and limitations of the completed solutions
- indirect benefits and opportunities
- constraints
- opportunities for technology-led modifications.

(9)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Activity 5 = 9 marks)

TOTAL FOR TASK = 60 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE