Quality
Introduction to Module 4

Quality is at the heart of the manufacturing industry and underpins all operations.

Employees will be asked to complete a wide range of checks at different stages of the production process; some of these will be qualitative checks and some will rely upon accurate measurement. All quality systems have a method of recording results and these will vary greatly from workplace to workplace. What is vital is that employees understand the importance of quality control and can contribute to the system effectively.

Many quality systems rely upon good number skills and accurate measurement skills. This module explores some of these skills in a variety of generic settings. It gives learners the opportunity to develop and practise skills in the following areas:

- understanding quality systems
- understanding units of metric measure
- accurate measuring and recording measures of length
- working within a tolerance
- weighing accurately
- reading gauges
- understanding temperature
- finding an average (mean)
- carrying out quality checks.

It would be impossible to reflect the wide range of settings in these materials. Teachers may need to adapt the materials using the Word version of the documents or to customise materials to their own work setting.

Production line manufacturing – Module 4: Quality					
Theme	**Page reference**	**NOS/NVQ**	**Literacy**	**Numeracy**	**Key Skills**
Quality control	Ma 4:1–4:2	223	Rw/E3.1	HD1/E2.3	
Units of measure	Ma 4:3–4:4	223	Rw/E3.5	MSS1/E3.8; MSS1/E3.9	
Measuring length	Ma 4:5–4:6	223		MSS1/E3.5; MSS1/L1.7	N1.1
Comparing length	Ma 4:7–4:8	223		N2/L1.4; N2/L1.5	N1.2
Working within a tolerance	Ma 4:9–4:10	220; 223		MSS1/L1.4; MSS1/L1.6; N2/E3.3	N1.1
Weighing accurately	Ma 4:11–4:12	223		MSS1/L1.4; N1/E3.1; N2/L1.4	N1.1
Reading gauges	Ma 4:13–4:14	223	Rt/L1.3	MSS1/L1.4	N1.1
Temperature	Ma 4:15–4:16	218; 219; 220; 223		MSS1/E3.9; MSS1/L1.4; N1/L1.2	N1.1; N1.2
Finding the average	Ma 4:17–4:18	220; 223		HD1/L1.3	N1.2
Quality checks	Ma 4:19–4:21	220	Rw/L1.2; Wt/L1.5	HD1/L1.1	C1.1; C1.3

Skills checklist

Whatever your role in the production process, you will be involved in some quality checks. These may involve precise measurements of materials or products and putting information into forms. You may be making visual checks for faults and rejecting products that do not meet the standard. It is important that all quality checks are carried out well so that sub-standard products do not go to the customer and that wastage is kept to a minimum.

The skills you need for quality checking will depend on your job. Look at the checklist below. Highlight the skills you need for your work. Tick those you are confident about already. Use the materials to work on skills that you have not ticked. Check the list again later to see if you have improved.

Skills for quality	Now	Later
Understanding quality control		
Understanding a range of measures		
Measuring length accurately		
Comparing measurements		
Understanding tolerance limits		
Weighing accurately		
Reading different gauges		
Understanding temperature		
Working out averages		
Making quality checks		

PAGES 4:1–4:2

Quality control

Occupational setting

Both quality control and the amount of wastage occurring in the production process are of paramount importance in manufacturing. Lean business practices require the production process to be as efficient as possible. This theme aims to look at some of the information that needs to be collected for quality control purposes, both quantitative and qualitative.

Materials

Pictures of manufactured items, and/or actual manufactured products

Small cards with quality control vocabulary written or printed on them

Learning outcomes

1 To recognise and understand technical words associated with the quality control process (focus page, Task 1)

2 To understand the general purpose and methods of quality control and the importance of accuracy (focus page, Task 2)

Suggested teaching activities

Introduction

- Begin by discussing the purpose of quality control systems, and what experience the learners in the group have of using them. What does quality control mean? How does it operate? What are the implications of not adhering to quality control systems?
- Show a photograph of a manufactured item or a real item not from the learners' own workplace (e.g. a car, a plastic pot with a lid, or a cake). Ask learners what kinds of things will be tested for quality. Write down the ideas in two columns, one for quantitative tests and one for qualitative tests. Ask learners whether they can tell the difference between the two lists. Explain that one is based on making judgements on criteria; the other is based on measuring criteria. Use another product as an example to check whether learners have understood the difference.
- Ask learners about the quality control processes in their own workplace. What kinds of tests are carried out and why?

Focus page

- Ask learners to cast their eyes over the focus page and look for words that are unfamiliar. Write up the words, pausing to sound out each syllable or chunk. Find definitions in a dictionary or in the glossary. Ask the group for sentences that put each word in context. Write these sentences up. Check in particular that learners understand what is meant by 'data', 'economical' and 'aroma'.
- In particular focus on the words 'qualitative' and 'quantitative'. Show the links with the words 'quality' and 'quantity'. This would be a good opportunity to look up the words in a dictionary, looking at the meanings of the root words.
- Look at the words on the page that are to do with taking measurements. Ask learners, working in small groups or pairs, to look at the pictures and find everything that can be measured, and decide what method could be used to take the measurements. Are there any other aspects or characteristics of a product that can be measured?
- Do the same for judging characteristics. You might like to take the opportunity to discuss issues around making objective judgments about quality. Are there problems with this? How can they be resolved?
- Write or print the vocabulary from the focus page onto pieces of card. Give each learner a picture of or an actual manufactured item. Ask individuals to use the word cards to build a word picture, similar to those on the focus page, of what kinds of attributes could be measured in the quality control process for that item.

- Learners could then present their word pictures to the group, explaining why they have chosen those words and what the quality control procedure might be. They should explain how their quality control would ensure the product:
  - is reliable
  - meets the needs of its users
  - is economical to produce.

Curric. refs	NOS/NVQ	Key Skills
Rw/E3.1 HD1/E2.3	223	N/A

Task 1

Understand and use technical words associated with the quality control process
Rw/E3.1

- Where learners are involved in the production of more than one product, ask them to choose one to focus on and write it in the centre of the diagram.
- Learners should use the vocabulary from the focus page to complete the 'word picture' about the quality control of that product.
- Help learners to look up the words in bold in the glossary where necessary.

If the learner has difficulty

- Ensure that learners understand the vocabulary used here. Use concrete examples if possible, for example measuring instruments, workplace products with quality problems.
- Allow learners to use vocabulary cards, copying the words from them into the spaces, but ask them to explain the meaning of each word to you or a partner.
- Discuss what could go wrong with the product, and what you would have to check to make sure it hadn't gone wrong. As you are holding the discussion ask learners to pick out the relevant key words from a selection of vocabulary cards. Help them to look for clues in the written words like the initial sound, the last syllable and the number of syllables in the word.

Extension

Ask learners to write a sentence on each quality control test they have selected, indicating what could go wrong if the product failed the test.

Task 2

Sort data into qualitative and quantitative
HD1/E2.3

Learners should use the controls they indicated in Task 1 to complete the table.

If the learner has difficulty

- Go over the meaning of the headings in each column, and go back to the focus page to remind the learner of the different kinds of data collection.
- Make cards for each control given for Task 1. Ask the learner to take each control and ask whether it is measurable or not. Make a pile of measurable controls and a pile of controls that are not measurable. Copy each pile into a column of the table.

Extension

Ask learners at what stage or stages of the production process each control should occur. Should some of the measurements be taken more than once? Why? Learners could draw a flow chart of the production process with quality controls indicated at the appropriate phase and describe the process to a partner.

Theme assessment

- Ask learners to use the table in Task 2 to explain the purpose of each control to a partner or small group.
- Learners could conduct an audit of quality measures from the workplace and sort them into qualitative and quantitative.

Quality control

Focus

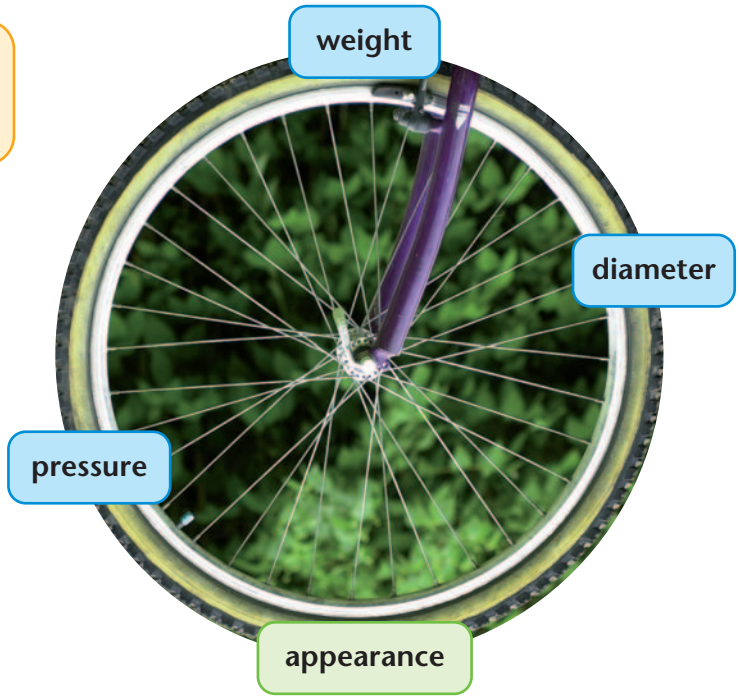
Quality control involves **collecting data** at each stage of manufacturing and then ***comparing*** it against a **standard** to make sure that quality is maintained.

Raw materials, tools, end products, wastage and **procedures** are all inspected.

Some data is collected by **taking measurements**. This is called **quantitative** data.

Examples:

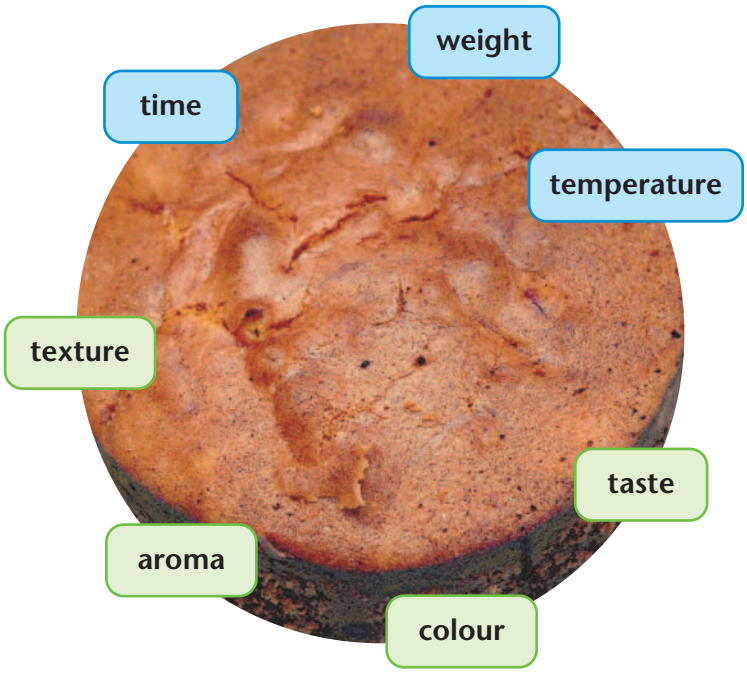
- temperature
- weight
- capacity
- time



Some data is collected by **judging characteristics**. This is called **qualitative** data.

Examples:

- colour
- appearance
- texture
- taste



All the data is **compared** against a **standard** level of quality.

The aim is to make sure that the product:

- is reliable
- meets the needs of its users
- is economical to produce.

Quality control

Task

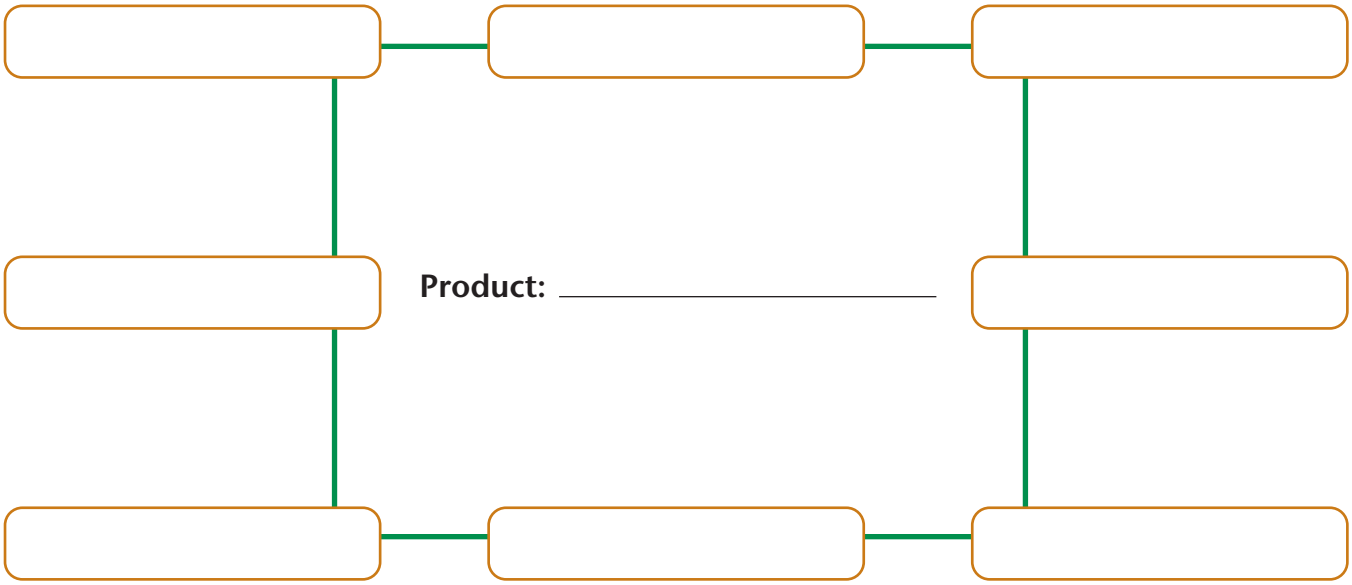
Task 1

What type of quality control data is collected for the product you are involved in making? Write in the spaces below.

Tip

Think about checks done on **raw materials**, **tools**, **machines**, **wastage** and **end products**.

Type of quality control data



Task 2

Sort your answers from Task 1 into the table below to show how each type of data is collected.

Data collected by measuring	Data collected by making judgements

Think about the quality control checks in your workplace.

PAGES 4:3–4:4

Units of measure

Occupational setting

Understanding units of measurement is fundamental to many manufacturing settings, in particular quality control. This theme looks at a range of units of measurement, found in many work processes. The theme deals with the language of measurement; many of the words are defined in the glossary, though it will be useful to expand on these with relevant concrete examples.

Materials

Examples of materials measured using different units of measurement, e.g. foods (weight, liquid measure), electrical equipment (volt, amp, watt, kilowatt), pressure (Pascal, bar), etc.

Dictionary

Learning outcomes

1 To understand a range of metric measures and what they measure (focus page, Task 2)

2 To know abbreviations for units (focus page, Task 1)

3 To know which instruments are appropriate for measuring length, weight and temperature (focus page, Task 3)

Suggested teaching activities

Introduction

- Ask learners how things are measured, and what units are used. For instance, how would you measure the distance between two places? Aim to get a good range of large and small measurement units, both metric and imperial. Ask learners to group the units, e.g. those for measuring weight, etc. Relate this to common everyday materials (e.g. a 1 kg bag of sugar, 500 ml shampoo, etc.).
- Relate this to work-based experience. What units of measurement are used at work?
- If necessary discuss the difference between metric and imperial units. Point out that some imperial units are still in common use today (miles, gallons, miles per gallon). Note also that the USA still uses imperial units. Emphasise however that metric units are now the accepted worldwide norm and that the maths is easier with metric measure as it is based on decimal units. You might want to demonstrate this with, for example, mm, cm and m. You could also look at length in imperial units (feet, inches). It is probably better not to look at trying to convert between units at this level, but to focus on understanding the metric system.

Focus page

- Look at the units shown on the focus page. What do they all measure? Discuss this and use the opportunity to use the glossary to check unfamiliar terms.
- Discuss the meanings of prefixes: kilo- (one thousand), milli- (one *thousandth*), centi- (one *hundredth*). This helps to group units and to understand their relationship. You could look up some of these words in a good dictionary, to see other words starting with the same prefix and what they have in common. Look at these units on the focus page. It would be helpful to dyslexic learners in particular if the prefixes were written on the front of a card with the meaning and an example on the back. The abbreviations could also be put on the back for reference.
- Look at the root words (gram, metre, litre, watt) – what do each of these measure? Cards can be used to link prefixes and root words.
- Discuss the use of abbreviations (shortened versions of words) – g = gram, m = metre, etc. Look briefly at how these abbreviations are formed. Are there any that could cause confusion? (e.g. mm/m, ml/l) Look at the symbol used for temperature (°C or °F) and discuss what this means.
- Ask how many millimetres there are in a centimetre, in a metre, etc. Write up this information. It might be a good idea to develop a chart showing common units used in the learners' work placement, with the appropriate abbreviations.

Curric. refs	NOS/NVQ	Key Skills
Rw/E3.5 MSS1/E3.8	223	N/A

Task 1

Abbreviations for units of measure
Rw/E3.5

- Explain the task to learners. This involves matching abbreviations to units of measure. You may have discussed this earlier.
- Remind learners about the focus page, which will help. Point out that the way the words are written on the page will help with the two-letter abbreviations. Give the example of mm being made up of the letters from the first part of the word (milli) and the second part (metre). It might be a good idea here to point out that micrometer is the only one that does not follow this rule – it has a special symbol (µ) to distinguish it from millimetre.

If the learner has difficulty

- Ask the learner to find the one-letter abbreviations first, by matching them with the first letter of the units.
- Support learners in matching the two-letter abbreviations to the words, one at a time. Remind them to look for the first letter of the first part of the word and the first letter of the second (coloured) part of the word for the ones that have two letters in the abbreviations.
- Ensure that spellings are copied correctly. Learners might also keep a glossary of the abbreviations and meanings. This will make a resource the learner can use as a memory aid later on.
- Some learners may have problems with visual memory, so checking the focus page will be difficult. Put the words onto cards for the learners to put in the correct places.

Extension

Find the abbreviations for all the other units of measure used on the focus page. A good dictionary should have these and learners should be encouraged to use a dictionary to find this kind of information.

Task 2

Sort units of measurement into categories
Rw/E3.5
MSS1/E3.8
MSS1/E3.9

- Discuss each of the categories on the table. Ensure learners understand what is meant by each one (e.g. force, capacity); definitions for these are in the glossary.
- Discuss strategies learners can use to complete the task (dictionary, glossary, Internet). Type 'define …' into the search engine and select 'Web Definitions' for Internet definitions.

If the learner has difficulty

- Go through the words on the focus page, looking specifically at the second part of the word and relating these to other words on the page that have the same ending.
- Ask learners whether they think it is a measure of length, weight, etc. Go through the better known ones first. Explain any words that learners may still be struggling with, such as 'capacity'.
- Write the words for them, to take away the burden of writing. Put words onto cards or sticky notes so that they can be moved around and sorted physically. These could be used as the basis for a quiz.
- Use any of the photos on the page as visual aids or, if possible, use examples of machines or tools from the learner's workplace that they may be more familiar with.

Extension

Sort the tools shown on the focus page into the different categories to show what each one measures. Suggest other tools used to measure the units shown on the table.

Task 3

Decide which instruments are used for collecting which data
Rw/E3.5
MSS1/E3.8
MSS1/E3.9

Discuss strategies learners can use to complete the task (knowledge of 'root words', dictionary, glossary, Internet).

If the learner has difficulty

- Read through the instructions and make sure learners are clear about what to do. If necessary, go through the first one as an example.
- Check learners understand the vocabulary used in the task. Assist them to check meanings in a glossary or dictionary.
- Check they know the difference between a micrometer and a micrometre. Dyslexic learners in particular may find this difficult. Draw attention to the fact that measuring instruments are called 'meters' (e.g. electricity meters). Point out the difference in pronunciation of micrometre and micrometer.

Extension

What can be measured using the other instruments?

Theme assessment

Learners could conduct an audit of measuring instruments used at work, with a list of what is measured and the units of measure used.

Units of measure

Focus

Quality control in manufacturing relies on precision. Everything is measured to a high level of accuracy. Here are some measuring devices and units of measure you might come across.

centimetre

centilitre

milligram

millimetre

millilitre

kilogram

kilowatt

kilometre

metre

litre

gram

watt

micrometre

° Celsius

tonne

amp

volt

Pascal

bar

Newton

Units of measure

Task

Task 1

Which units of measure have the following abbreviations?

1 cl _____ 6 l _____

2 cm _____ 7 mg _____

3 g _____ 8 ml _____

4 kg _____ 9 mm _____

5 kw _____ 10 V _____

Tip

Use the focus page to help with spellings.

Task 2

Sort the units of measure on the focus page into the following table.

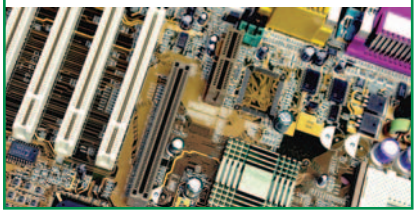
length	**weight/mass**
capacity	**pressure**
	force
electrical units	**temperature**

Task 3

Draw lines to show the measuring device used for collecting the data.

thermometer | pressure gauge | micrometer | weighing scales | voltmeter

1 The voltage in a circuit



2 The thickness of a washer

3 The size of a portion of dough

Rw/E3.5; MSS1/E3.8; MSS1/E3.9

PAGES 4:5–4:6

Measuring length

Occupational setting

Learners working in many areas of manufacturing will need to be able to measure dimensions. This theme develops the number and measurement skills required to measure accurately. Learners will need to practise this using the measuring instruments used in the work environment. There is no substitute for practical measuring activities and learners should be encouraged and supported to do this as much as possible. Please note that it is difficult to find a 'standard' tape or rule. Variations in these are wide-ranging and will have a real impact on the learner's ability to measure and record measurements accurately.

Materials

A selection of rulers including a metre rule, plastic rulers and engineering rulers, 15 cm and 30 cm sizes

Callipers or dividers

A selection of objects to measure

Learning outcomes

1 To be aware of the importance of accurate measuring in achieving quality standards and to know the metric units used (focus page)

2 To measure accurately using centimetres and millimetres (focus page, Tasks 1 and 2)

Suggested teaching activities

Introduction

- Talk about metric units. Establish if the metric system is the one used by learners when measuring length. It may be necessary to explain that 10 mm = 1 cm, 100 cm = 1 m, etc.
- If necessary, discuss the relationship between metric and imperial systems, e.g. 1 metre is about 39 ins, 30 cm is roughly 1 ft, 25 mm is roughly 1 inch. This should only be done if learners need to understand these equivalences.
- If necessary, demonstrate the equivalences using a metre rule and rulers with both metric and imperial measurements marked on them. Read across the ruler from the 1-inch mark to 25 mm on the opposite edge, etc.
- Explain that these rough estimates are OK in everyday life but that in manufacturing, accuracy is very important and mistakes can be very costly. Ask learners to think of some examples from the workplace where a high degree of accuracy is required.
- Display a variety of rulers and ask for comments on the differences between them. Some will be wood or plastic and have a 'bit extra' on each end to allow for damage. Some steel engineering rulers do not have this extra bit as they can resist being dropped without being damaged. Explain what consequences this has for where the '0' on the ruler is. On engineering rulers measuring starts from the end of the ruler, whereas on other rulers measuring starts from a little way in.
- Ensure that the learners understand that measuring starts from the '0' on the ruler and that this is often not marked on the ruler. The first number is often 1. Make sure that the learners understand that the '1' is not where to start measuring from.

Focus page

- On the focus page draw attention to the units of measurement and the abbreviations at the top of the page.
- Draw attention to the most commonly used units.
- Explain that a micrometre is a very small unit of length (one thousandth of a millimetre). Ask learners to look at 1 mm on a ruler and try to visualise how small a micrometre might be. Would they be able to see it? Point out that micrometres are sometimes referred to as microns.
- Some learners may have heard the term micrometer used to describe a particular measuring instrument. If possible show the learners a micrometer and explain that it is used to measure things very accurately.

- Point out the differences between the two rulers illustrated and draw attention to where the measuring should start from.
- In the question 'How many mm in 3.5 cm?', check that the learners understand decimal notation. You may need to explain that 1 mm = 0.1 cm, 2 mm = 0.2 cm, etc. Dyslexic learners may need further support to convert measurement.
- Talk through how the micrometer works in relation to 3-D objects. Talk about how the diameter of a circle is measured. You might want to extend this to look at the use of Vernier callipers.
- Set a range of measuring tasks using the instruments you have to hand. Ensure that learners measure as accurately as possible.
- Ask learners to describe what they measured, the tools they used and their results, highlighting any difficulties.

Curric. refs	NOS/NVQ	Key Skills
MSS1/E3.5	223	N1.1
MSS1/L1.7		

Task 1

Measure accurately in mm
MSS1/E3.5

- This task can be conducted as a whole-group activity if required. Check that learners are clear about the dimensions of the 'blade' that they are measuring and how to record them on the chart.
- Check that they are clear about what units they are measuring in.
- Check that they are able to identify where the units are marked on their rulers: millimetres and centimetres.
- Check that they are clear about starting measuring from '0', which may or may not be at the end of the ruler depending on its type.
- Check that they know how to convert centimetres to millimetres if necessary. You may need to reinforce the fact that 10 mm = 1 cm.
- Stress the need for accuracy.

If the learner has difficulty

- If learners are unsure about centimetres and millimetres, make sure they have a ruler marked only in millimetres.
- You may need to point out to the learner where to start measuring from on the ruler.
- You may need to point out to the learner where to start measuring the 'blade' from and to – start at the arrow near the letter a, b c or d and measure to the exact place where it finishes.
- Some learners may have difficulty accurately pinpointing the correct measurement on their ruler. It may help if you put the point of a pencil on the correct measurement while the learner counts the number of millimetres. Dyslexic learners may also need help with tracking along the ruler or tape.
- You may need to steady the ruler for the learner while they read off the scale.
- Good visual skills are needed for this task. Allow the use of a magnifying glass if necessary.
- If learners still have problems, provide equivalent measures written on cards for learners to match up.

Extension

- Have a selection of objects for learners to measure.
- Ask learners to measure objects using a ruler marked in centimetres and write down the measurements in millimetres.
- Ask learners to convert measurements in centimetres to millimetres. Use different levels of difficulty, e.g. 2 cm, 24 cm, 24.5 cm, 12.8 cm.

Task 2

Measure accurately in mm
MSS1/E3.5

- Check that learners understand the idea of the diameter of a circle. Draw their attention to the definition that accompanies the task. The diameter is the dotted line on the drawing.
- Stress the importance of the idea that the diameter of a circle goes through the centre of the circle. If the line does not go through the centre you are not measuring the diameter and your measurement will be too short.

- Explain that measuring the diameter is necessary when measuring the size of a bar of metal or a pipe.

If the learner has difficulty

- Explain that even though they are measuring the size of a circle they are still measuring a straight line and all the same considerations in Task 1 still apply.
- Give the same help, if necessary, as for Task 1.

Extension

Ask learners to measure the diameters of a selection of bars or pipes using callipers. Set the callipers to the widest point on the pipe or bar and measure the distance between the points of the callipers with a ruler.

Theme assessment

- Learners measure a selection of everyday objects and give measurements in millimetres.
- In pairs, one learner draws a line to a length of their choice for their partner to measure. The first learner checks the accuracy of the second learner's measurement. Change roles.

Measuring length

Focus

In many areas of manufacturing, widths and lengths are crucial to the quality of the finished product. Accurate measuring is therefore extremely important.

*Which **dimensions** are important in the process you're involved with?*
*Which **units of measurement** are used?*

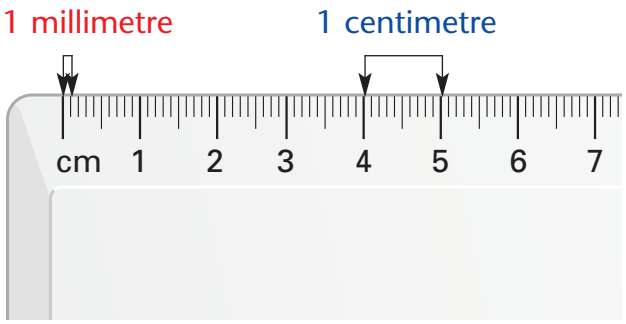
Millimetres or fractions of a millimetre called micrometres are usually used.

micrometres are sometimes called 'microns'

Metric units of measurement

metres (m)	1 m = 100 cm
centimetres (cm)	1 cm = 10 mm
millimetres (mm)	1 mm = 1000 µm
micrometres (µm)	

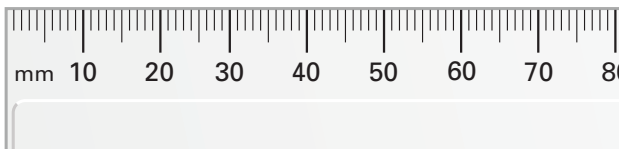
Millimetres are the tiny marks shown on a ruler.
Most standard rulers are marked in **millimetres** and **centimetres**, but only the centimetres are numbered.



*How many **mm** in **4 cm**?*
*How many **mm** in **3.5 cm**?*

Remember!
10 mm = 1 cm

Special engineering rulers are labelled every **10 millimetres**.



Micrometres are too small to measure with a ruler.

Special tools such as this digital micrometer can measure to this degree of accuracy.

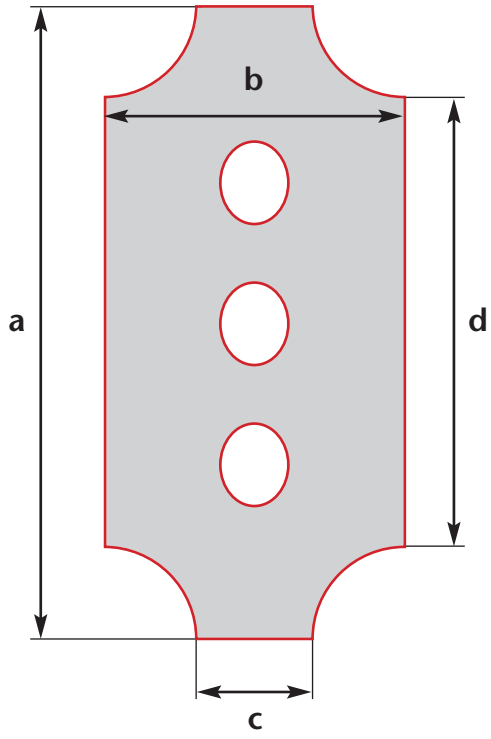
Measuring length

Task

Task 1

1 Use a ruler to measure the dimensions of this blade accurately in mm.

2 Complete the table.



Tip

If you are not using a special engineering ruler, remember:

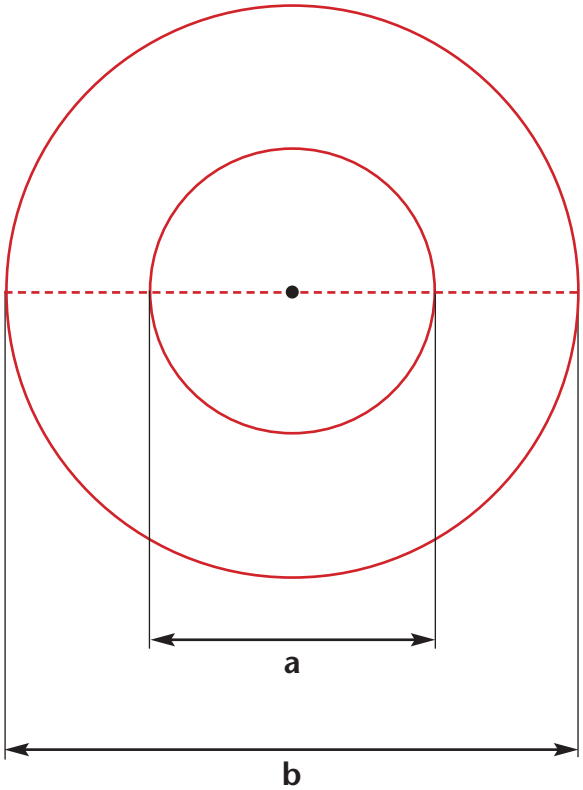
1 cm = 10 mm

FIRST-OFF PRODUCTION RUN APPROVAL PRODUCT: MP4 Blade MACHINE: HH3			
a	**b**	**c**	**d**
_____ **mm**	_____ **mm**	_____ **mm**	_____ **mm**
KEY a = overall length c = length of non-cutting edge		b = overall width d = length of cutting edge	

Task 2

1 Use a ruler to measure the diameters of this component accurately in mm.

2 Complete the table.



Tip

A **diameter** is a straight line drawn through a circle, passing through the centre.

FIRST-OFF PRODUCTION RUN APPROVAL PRODUCT: ZB5 Washer MACHINE: K097		
Time	**Diameter a**	**Diameter b**
19:18	_____ **mm**	_____ **mm**
KEY Diameter a = component		Diameter b = hole

Measure accurately using a range of measuring instruments.

PAGES 4:7–4:8

Comparing length

Occupational setting

The ability to read, write down and compare small measurements accurately is likely to be a crucial skill for workers involved in quality control. This theme looks at place value, particularly in relation to fractions of a millimetre.

Materials

A variety of different measuring instruments and gauges

Small objects or components to measure

Learning outcomes

1 To understand measurements to three decimal places (focus page, Tasks 1 and 2)

2 To compare measurements (focus page, Tasks 1 and 2)

3 To calculate the differences between measurements (focus page, Task 2)

Suggested teaching activities

Introduction

Ask learners what experience they may have of measuring small components. What instruments have they used, if any? What are the problems they are likely to have when measuring and comparing components? Stress the need for accuracy, and discuss why it is so essential.

Focus page

- This focus page looks at place value in terms of millimetres and fractions of millimetres.
- Ask learners to look at the illustration of the gauge. Ensure that everyone understands how to read the display. Remind learners that digits after the decimal point are pronounced individually, i.e. the reading is pronounced as 'four point seven five two'.
- If necessary, write down other decimal numbers, or use a gauge to measure small objects, and ask learners to read out the measurements.
- Go on to consider the actual meaning of the measurement. Draw a short number line showing the whole numbers 4 and 5. Ask learners to point to the position on the line where they think 4.752 would be.
- Use the number line to illustrate the concept of place value. Start by marking a point halfway between 4 and 5. Ask learners what that measurement is. Show on the number line that each whole unit (or millimetre) is divided into ten **equal** parts that are called tenths. The point halfway between 4 and 5 is therefore 4.5 (four whole millimetres and five tenths of a millimetre).
- Invite learners to show the position of 4.7 on the number line.
- Draw another number line, to show the numbers 4.7 and 4.8. Show that tenths can be further divided into ten equal parts, called hundredths. Why are they called hundredths? Learners should now be able to understand that there are 100 hundredths in one whole unit. Ask learners to show where the number 4.75 is on the line. Ask what measurements the other divisions represent.
- Draw another number line, showing 4.75 and 4.76. Show that hundredths can be divided into ten equal parts, each called thousandths. How many thousandths are there in one whole unit? Ask learners to show where the number 4.752 is on the line. Label the other divisions.
- If necessary, continue to draw number lines to illustrate other decimal numbers, until learners show that they feel confident with the concept.
- Go on to look at the table on the focus page, showing millimetre place values, and the relationships between each column. It may be useful to discuss zero as a place holder immediately after the decimal points, extending the example in the table. The link could be made with zero as a place holder in the whole number.
- Explain that the easiest way to compare measurements is by considering the values of each place value column. It may be worth mentioning that individual column values

always increase from right to left, i.e. hundredths > thousandths, tenths > hundredths, etc.

- Draw other place value tables to illustrate and compare other numbers.
- Ensure that learners understand that putting zero at the end of a decimal number does not affect its value, for example 4.5 = 4.50 = 4.500. However, point out that the level of accuracy is indicated by the number of decimal places shown.
- Give learners time to use different gauges to do some measuring. Ask a variety of appropriate questions. For example, *This component is 8.360 mm wide and this one is 8.361 mm wide. Which is wider? By how much?*

Curric. refs	NOS/NVQ	Key Skills
N2/L1.4 N2/L1.5	223	N1.2

Task 1

Read, write and compare decimal measurements up to three decimal places
N2/L1.4

- Explain the task.
- Remind learners of place values already discussed on the focus page.
- Encourage learners to write down the pairs of numbers underneath each other, lining up the decimal points and the columns. This makes comparison much easier.

If the learner has difficulty

- Show the learner how to write down the numbers underneath each other, lined up correctly, to help comparison. Squared paper will help this, especially for dyslexic learners or those with visual discrimination difficulties. Learners with visual discrimination difficulties may also benefit from practising with a large red dot as the decimal point.
- If necessary work through the task together.

Extension

Write down the eight measurements from Task 1 in a list in order of size, smallest to largest.

Task 2

Read, write down, compare and find the difference between decimal measurements up to three decimal places
N2/L1.4
N2/L1.5

- Learners have to complete the table by subtracting numbers with three decimal places.
- It would be a good idea for them to do this task on paper first. A calculator could be used as a check.

If the learner has difficulty

- Does the learner understand the task and how to record the answers?
- Encourage the learner to break down the task into smaller parts. For example, first they could decide if the cut component is larger or smaller. Then they can circle the *larger* measurement so that they know which column to write the answer in. Next they write down the two measurements, one underneath the other, with the larger measurement on top. Learners can then do the calculation and write down the answer.
- Use the above method to show how the answers to the first two checks were found.
- Use a calculator as a check. Make sure the learner knows how to use the calculator correctly, in particular the order of keying in digits and functions.
- Dyslexic learners may have problems with the sequence of numbers in this task. Observe them doing the calculation and watch for this in particular. Careful checking is required.
- Watch out for learners omitting zeros in calculations – further work on the value of zero as a placeholder and place value may be required. See *Skills for Life* materials at Entry 3 for additional work.

Extension

- Multiply each of the pairs of measurements in Task 2 by ten (use a calculator if necessary).
- Give learners different pairs of measurements to work out.

Theme assessment

- Choose five components from a batch made at work. Measure the length and width of each component. Record the results. If the measurements are different, write them in order of length, from the shortest to the longest. Work out the difference in size between each component. If you do not have access to suitable components, try measuring five identical gauge screws, or the lengths of five matches taken from one box.
- Get learners to talk through the process and describe how they deal with calculations. Stress the importance of giving reasons or explanations for any differences.

Comparing length

Focus

Quality control involves reading, writing and comparing measurements.

The component is **4.752** mm wide.

What does that mean?

*Is it **bigger** than 4 mm?*

*Is it **smaller** than 5 mm?*

The positions of the **digits** in a measurement are important. To understand and compare measurements, think of each **digit** as being in a separate column.

Whole millimetre values sit to the **left** of the decimal point.

The decimal point separates the whole millimetres and the fractions of a millimetre.

Fractions of a millimetre (micrometre) values sit to the **right** of the decimal point.

*Hundreds are bigger than tens and units. **Tenths** are bigger than **hundredths** and **thousandths**.*

millimetres			.	**fractions of a millimetre (micrometres)**		
Hundreds	Tens	Units	.	tenths	hundredths	thousandths
		3	.	**5**	**0**	**0**
		4	.	**5**	**0**	**0**
		4	.	**7**	**0**	**0**
		4	.	**7**	**5**	**0**
		4	.	**7**	**5**	**2**

4.500 mm is bigger than 3.500 mm by 1.000 mm (**1** millimetre)

4.700 mm is bigger than 4.500 mm by 0.200 mm (**2 tenths** of a millimetre)

4.750 mm is bigger than 4.700 mm by 0.050 mm (**5 hundreths** of a millimetre)

4.752 mm is bigger than 4.750 mm by 0.002 mm (**2 thousandths** of a millimetre)

Comparing length

Task

Task 1

Tick the bigger measurement in each pair.

1 **12.050** mm ☐ **12.500** mm ☐

2 **12.050** mm ☐ **12.005** mm ☐

3 **12.505** mm ☐ **12.055** mm ☐

4 **12.075** mm ☐ **12.705** mm ☐

Tip

You might find it easier to compare the numbers if you write one beneath the other and line up the decimal points.

0.400 is bigger than **0.040**

because 4 tenths is bigger than 4 hundredths.

Remember!

- Tenths are bigger than hundredths.
- Hundredths are bigger than thousandths.

Task 2

1 Check to see whether each component has been cut to the size on the gauge.

2 Calculate how much larger or smaller the component is.

3 Complete the table.

Tip

Subtract the smaller measurement from the larger measurement to find the difference in size.

CALIBRATION CHECK

PCB GUILLOTINE
METHOD: Make cut. Check if cut length of component matches the size on the gauge. Record size difference.
Please return to QA Office when completed.

MACHINE	SIZE ON THE GAUGE	CUT SIZE OF COMPONENT	Cut size is ***smaller*** than gauge size by:	Cut size is ***larger*** than gauge size by:
DDE	**50.250 mm**	**50.230 mm**	**0.020 mm**	
DDF	**10.500 mm**	**10.600 mm**		**0.100 mm**
DDG	**15.125 mm**	**15.120 mm**		
DDH	**50.900 mm**	**50.950 mm**		
DDJ	**40.050 mm**	**40.550 mm**		
DDK	**91.500 mm**	**90.500 mm**		
DDL	**55.750 mm**	**55.950 mm**		

Compare measurements and calculate the difference between them.

PAGES 4:9–4:10

Working within a tolerance

Occupational setting

It is common in many aspects of production to work within tolerances. Tolerances vary between products and dimensions (e.g. the length of a cylinder may have a different tolerance to the diameter of the same cylinder). Many engineering parts are required to be made to very small tolerance levels, of the order of fractions of a millimetre or microns. The numeracy involved in working within a tolerance includes understanding metric measurement, decimal place and zero as a placeholder, and calculating with measurements. Watch out for any learners working in a setting where tolerances are expressed in percentage terms, e.g. ± 0.5%. This adds a further layer of complexity, not dealt with in this theme.

Materials

Workplace examples of tolerance levels

Examples of products where one part needs to fit inside another (e.g. piston in a car engine, refill for a biro)

Learning outcomes

1 To recognise the plus and minus symbol that denotes tolerance (focus page, Tasks 1 and 2)

2 To understand acceptable tolerances within a range (focus page, Tasks 1 and 2)

3 To calculate in millimetres (Tasks 1 and 2)

Suggested teaching activities

Introduction

- Write the word **tolerance** and ask the group what it means to them. If anyone says that it means putting up with things not being quite right/to their liking then they have got the right idea. Put it in the context of manufacturing, stressing the amount of tolerance allowed is often very small, sometimes only tenths or hundredths of a millimetre. Ask learners to look at their tape measures to see just how small 1 mm really is. Point out that 0.2 mm is even smaller than this. It is two tenths of a millimetre.
- Draw the symbol for plus or minus next to the word tolerance and question learners on what they think it means.
- Question learners about what might happen if manufacturing tolerances are not met.

Focus page

Note: teachers might prefer to have a specific workplace example of tolerance (which might be weight) to go through in a similar way to the focus page, either before or after looking at the focus page example of the piston.

- Discuss words like **intended**, **diameter**, **tolerance**, **acceptable**, **cylinder**, to ensure that learners understand what is being illustrated here.
- Ask learners why the first line of pistons shown on the page are considered acceptable. Then ask why the bottom two pistons are **not** acceptable.
- Discuss the implications of making pistons that are outside the agreed 0.2 mm tolerance. (Gas could escape if the piston is made too small. Interference could occur if the piston is made too large, or it just wouldn't fit.)
- Ensure that learners understand that sizes are acceptable within a range. Ask what is the largest acceptable size for the piston. What is the smallest acceptable size?
- Focus now on the 0.2 mm tolerance. Remind them that it is a very tiny amount. Ask for another way of saying this measurement. (Two-tenths of a millimetre.) Learners may not understand this equivalence – if you feel further work is needed in this area, use *Skills for Life* materials, Entry 3 Unit 4.
- Ask learners to look at the specifications for the cylinder. What is the intended size? What is the tolerance? Write these on the board. Look at a real piston, demonstrating how the piston fits inside the cylinder and moves freely.

- Use a set of circular cards **marked** with different diameters to represent cylinders that have been made. Ask learners to sort them into two sets – acceptable and not acceptable. Point out that it is not possible to see this difference by eye because it is so small.
- Ask learners to say what the smallest acceptable size and largest acceptable size are.
- Ask learners to suggest ways of calculating the smallest and largest acceptable size when given a specification and a tolerance.
- Ensure that learners have strategies to carry out the calculations either on paper, in their heads or using a calculator.
- Ask learners to say what might happen or could happen if the cylinder is not within the tolerances and someone tried to fit a piston into it.

Curric. refs	NOS/NVQ	Key Skills
MSS1/L1.4	220	N1.1
MSS1/L1.6	223	
N2/E3.3		

Task 1

Check tolerance levels
MSS1/L1.6
N2/E3.3

Remind learners how to calculate the smallest and largest acceptable size when given a specification and a tolerance.

If the learner has difficulty

- Find out the strategies the learner is using to carry out their calculations. It might be useful to observe the learner actually doing a calculation, so that you can spot where the error is occurring or ask the learner to describe what they are doing.
- Try giving the learner some calculations using whole number tolerances.
- Understanding the decimal place may be a problem for many learners here. If this is not understood, learners must have specialised support before they can cope with these tasks. Materials from *Skills for Life* numeracy packs can be used to support learning (Entry 3 Unit 4).
- Watch out for sequencing errors (i.e. correct digits, incorrect order). This may be a problem for dyslexic learners. Try getting them to read the measurements aloud, pointing to each digit at the same time.

Extension

- Using the example on the focus page, what are the maximum and the minimum **acceptable** differences in size between a piston and a cylinder?
- Tip: Find the maximum acceptable difference by subtracting the smallest acceptable piston size from the largest acceptable cylinder size. Find the minimum acceptable difference by subtracting the largest acceptable piston size from the smallest acceptable cylinder size.

Task 2

Measure and check tolerance levels
MSS1/L1.4
MSS1/L1.6
N2/E3.3

Remind learners that they have to bear in mind the 3 mm tolerance. As they measure the spindles, they have to ask themselves, 'Is it more than 3 mm shorter or more than 3 mm longer than 70 mm?'

If the learner has difficulty

- Check that the learner is using the ruler accurately, for example starting the measurement at '0', reading the scale on the ruler accurately. If there are problems with accurate measurement, look at the 'Measuring length' theme, or use *Skills for Life* materials.
- Ask the learner to give you some simple millimetre measurements (e.g. 25 mm, 9 mm, etc.). As they are given to you, draw them on paper, making each line slightly too long or slightly too short. Measure the lines with the learners, to see if they fall within the tolerance of 3 mm. Return to the original task and look at one measurement.
- Be aware that learners with visual discrimination difficulties may find this task difficult.

Extension

- Ask learners to record the differences between the actual measurements of the spindles and the target measurements. By how much are they over or under the target measurement?
- Investigate tolerance in a practical situation, e.g. a shelf made to fit a cupboard must be a certain length. Investigate the tolerance. Which length is too small? Which length is too big? What is the tolerance?

Theme assessment

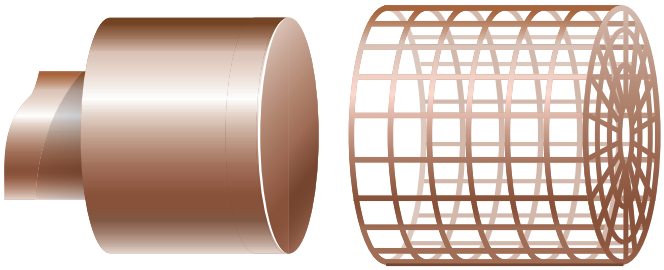
Set some problems based on the tolerance levels actually used in their workplace settings. This should focus on accurate measurement, relating the required tolerance levels to these measurements and calculating whether items fall within the tolerance levels. Ask learners to write a comment on the tolerance levels.

Working within a tolerance

Focus

When parts are made, the size is not always exact.
However, parts must be made to acceptable standards.

If the **piston** is to fit inside the cylinder, the piston must be **narrower**.



If the **cylinder** is to accept the piston, the cylinder must be **wider**.

How much narrower? How much wider?
Take a look at the job sheet below.

Job sheet			
CODE	**DESCRIPTION**	**SPECIFICATION**	**TOLERANCE**
DS114	Piston	Diameter = 120.0 mm	± 0.2 mm
DS155	Cylinder	Diameter = 121.0 mm	± 0.2 mm

A **tolerance** tells you **how much** a measurement is allowed to **differ** from the intended size.

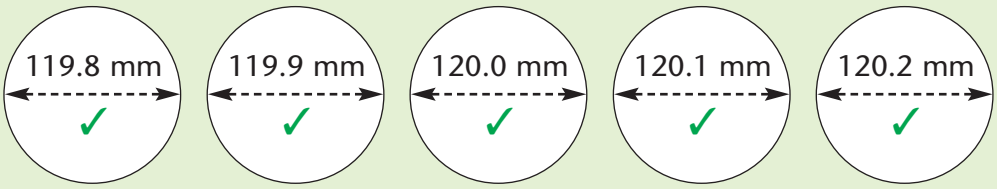
A **specification** tells you the **intended size**.

Tolerances are written using this symbol: ± which is read as **plus or minus**.

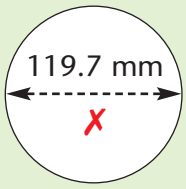
According to the Job sheet above, a piston must have a diameter of **120 mm ± 0.2 mm**.

This means no wider than 120 + 0.2 mm (120.2 mm), and no narrower than 120 – 0.2 mm (119.8 mm).

Pistons made with the following diameters **are** acceptable:

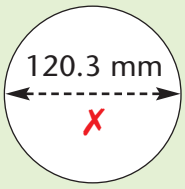


Pistons made with the following diameters **are not** acceptable:



This piston is **too narrow**.

This piston is **too wide**.



Working within a tolerance

Task

Job sheet			
CODE	DESCRIPTION	SPECIFICATION	TOLERANCE
AH145	Spindle	Length = 70 mm	± 3 mm
		Diameter = 10 mm	± 0.5 mm

Remember!

Specification tells you the **intended size**.

Tolerance tells you **how much** a measurement is allowed to **differ** from the specification.

Task 1

Use the job sheet above to answer the questions.

1 What is the shortest acceptable length for a spindle? _____ mm

2 What is the longest acceptable length for a spindle? _____ mm

3 What is the smallest acceptable diameter for a spindle? _____ mm

4 What is the largest acceptable diameter for a spindle? _____ mm

Task 2

These spindles have been made according to the above specifications. Tick the spindles that are of acceptable length. Put a cross by the spindles that are not of acceptable length.

1

2

3

4

Tip

Use a ruler to measure the length of each spindle.

Calculate the smallest and largest acceptable size for a given specification and a tolerance.

PAGES 4:11–4:12
Weighing accurately

Occupational setting

In manufacturing, the ability to read and interpret weights accurately may be crucial to the quality and production cost of the finished product. This theme develops the skills of weighing accurately and understanding digital readouts.

Materials

A selection of weighing machines as may be used in the work setting, to give examples of different forms of display

A selection of suitable objects to weigh

Learning outcomes

Read, measure and compare weights using digital readouts in kilograms and grams (focus page, Tasks 1 and 2)

Suggested teaching activities

Introduction

- Explain that in many areas of manufacturing, to be able to weigh materials and finished products accurately is an essential skill, and this theme will look at the accurate reading of metric weights.
- Ask learners what experience they may have of using weighing machines in their own workplace. Encourage discussion about the possible reasons for accuracy in different situations. Try to consider the amounts of materials needed for the manufacturing process itself, the costs involved, wastage etc. What might be the consequences of inaccurate weighing or misreading of weighing scales?
- Go on to consider the different units of weight of which learners may have experience. Explain that the most common units that they are likely to be asked to use now are the metric units based on kilograms. If imperial weights are offered by learners then say that these are mostly not used now.

Focus page

- Discuss the relationship between kilograms, grams and milligrams. It may be useful here to explain that the prefix 'kilo' always refers to 1000 and 'milli' to one thousandth, e.g. the word kilogram means 1000 grams and the word milligram means one thousandth of a gram. Can learners think of any other words (especially in relation to measurement), that begin with 'milli' and 'kilo'? Hopefully, your list of suggestions will include kilometre, millimetre, millilitre, and millennium as good examples. You might like to use a dictionary to support this activity. For learners with poor memories, put definitions on cards and ask learners to do a matching activity, linking prefix, base and number.
- Demonstrate that different weighing machines may display weights in different formats. Use either the illustration on the focus page or some actual weighing machines to show this. Has anyone used a machine with a different form of display? Some learners may have experience of using a machine with a dial and pointer. Ask what the disadvantages may be of using that sort of machine. (A dial and pointer is unlikely to be an accurate way to measure weight because it relies on human interpretation of where the pointer has come to rest.) A digital display is the most accurate display.
- Point out that digital displays may give readings in kilograms or grams. If the reading is in kilograms, the decimal point is important as it separates the whole kilograms from the fractions of a kilogram. If the scales are used for weighing very light amounts, or for very high accuracy, then the display is more likely to be in grams or milligrams.
- An important point to be made here is the different function of a zero at the end of decimal numbers and whole numbers. Look at this in relation to the examples on the page (1.250 kg and 1250 g).

- It is usual for a kilogram display to be given to three decimal places, so that the digits after the decimal point actually refer to grams. However, if a display reads 1.25 kg, that is exactly the same as a reading of 1250 g. The zero at the end of the decimal part of the reading is just a place holder – it makes no difference to value of the number.
- In a whole number display, a zero at the end of the number **does** make a difference to the value. Ask learners what would happen to the value of the reading on the right of the focus page if the zero were ignored. It should be obvious that 125 g is not the same as 1250 g.
- You may also like to consider a kilogram reading in the form 1.025 – how should that be interpreted in terms of kilograms and grams? In this case the zero is not at the end of the number, so it **does** have a value. 1.025 kg is read as 1 kg and 25 g.
- If you have a selection of weighing machines and objects, ensure that everyone in the group is able to weigh objects and interpret the displays accurately. Give everyone the opportunity to use machines with different displays.
- Note: these may be difficult concepts for some learners, especially dyslexic learners, but they might understand the ideas better if they use cut-out numbers and a large decimal point, as learners can physically move these around.

Curric. refs	NOS/NVQ	Key Skills
MSS1/L1.4 N1/E3.1 N2/L1.4	223	N1.1

Task 1

Read, write and compare metric weights given to three decimal places
N2/L1.4
MSS1/L1.4

- Make sure learners are aware that the '25 kg × 11 bags sugar' means 11 bags of sugar each weighing 25 kg and they are to match the scale weight to the 25 kg. This is to avoid any confusion with learners thinking they have to multiply it.
- Explain the task and ensure that learners know how to write down their answers. They may wish to join corresponding weights with lines on the sheet, or they may rewrite the ingredients, giving the correct corresponding reading.
- Remind learners that zeros at the end of the decimal part of a number make no difference to the **value** of the reading.

If the learner has difficulty

- Does the learner understand how to compare the readings with the given weights?
- Work through the first few ingredients together if necessary. It is useful to suggest the strategy of doing the ones you know first then looking at the more difficult matches.
- Check the learner understands about zero as a placeholder and the different ways of noting weights such as 0.2 kg and 0.200 kg.
- If learners are drawing lines to match things up, encourage them to use a ruler and join all the lines from either the weight or the ingredient. This should help with clarity.
- For some learners and including those with visual difficulties, it might be a good idea to make cards showing the weights and ingredients and match them this way.

Extension

Write each of the displays from Task 1 as they would appear on a weighing machine that measured grams instead of kilograms.

Task 2

Read, write and compare metric weights given as whole numbers
N1/E3.1
MSS1/L1.4

- Explain the task and how to write the answer.
- Suggest that learners need to consider the place value of each digit (i.e. is it in the thousands column, the hundreds column, etc.?). Point out the tip for this task to help them do this.
- Rewriting the weights in a list and lining up columns may help, as may making cards showing the weights.

If the learner has difficulty

- Does the learner understand the task and how to write the answer?

- It may help to rewrite the weights underneath one another, with the columns lined up, then demonstrate how to compare digits one column at a time, starting with the thousands.
- Some learners will prefer to do this task using cards to order the numbers. Good visual skills are required for distinguishing numbers such as 1150 and 1105.

Extension

Write each of the displays from Task 2 as they would appear on a weighing machine that measured kilograms instead of grams.

Theme assessment

Use a weighing machine with a digital display to weigh five similar-sized objects (if possible use a weighing machine that is used in the workplace). Write down the display for each item as it appears on the machine. What does each display mean? Write the five weights in order of size, smallest to largest.

Weighing accurately

Focus

In many areas of manufacturing, accurate weighing is crucial to the **quality** of the finished product. It is also important for controlling **costs**.

When are **weights** important to the processes you're involved with?

Which **units of weight** are used?

Weights are measured for:
- *product recipes*
- *portion control*
- *wastage.*

Kilograms or grams are used most often in manufacturing. Extremely light weights are measured in milligrams.

Metric units of weight

kilograms (kg)	
grams (g)	1000 g = 1 kg
milligrams (mg)	1000 mg = 1 g

Different weighing machines show weights in different ways. These two digital readouts show the same weight. (**1.25 kg**)

This digital readout shows the weight in **kilograms** to 3 decimal places.

The **decimal point** separates **whole kilograms** from **fractions of a kilogram** (grams)

How are weights displayed on the machines you work with?

This digital readout shows the weight in **grams**.

Just grams are shown.

Zeros after the final digit to the right of the decimal point *make no difference to the value of the number.*

Examples

1.000 kg means the same as 1 kg

1.250 kg means the same as 1.25 kg

Zeros *make a lot of difference to the value of* ***whole*** *numbers.*

Examples

1000 g ***does not*** *mean the same as 1 g*

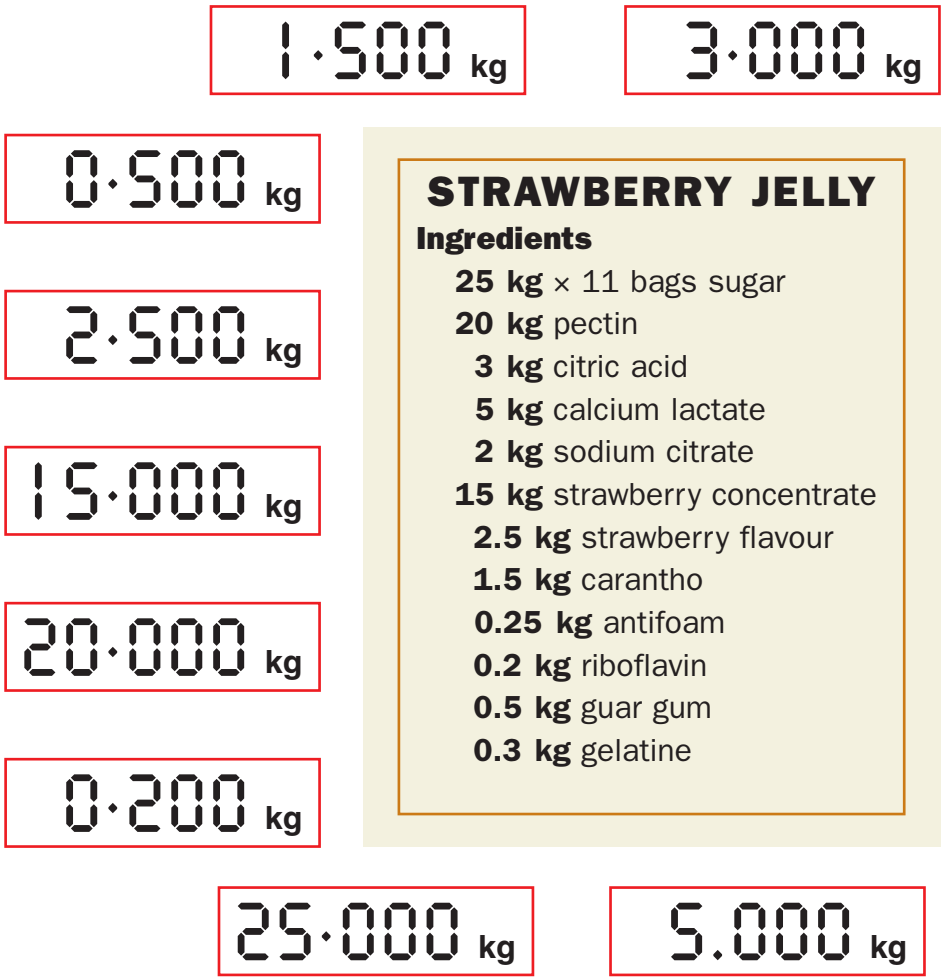
1250 g ***does not*** *mean the same as 125 g*

Weighing accurately

Task

Task 1

Match the weights on the scales to the ingredients in the recipes.



STRAWBERRY JELLY

Ingredients

- **25 kg** × 11 bags sugar
- **20 kg** pectin
- **3 kg** citric acid
- **5 kg** calcium lactate
- **2 kg** sodium citrate
- **15 kg** strawberry concentrate
- **2.5 kg** strawberry flavour
- **1.5 kg** carantho
- **0.25 kg** antifoam
- **0.2 kg** riboflavin
- **0.5 kg** guar gum
- **0.3 kg** gelatine

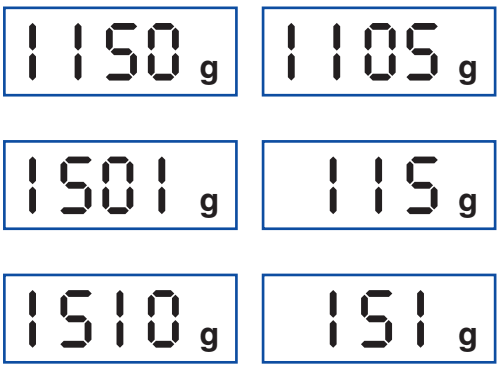
Tip

Zeros shown after the final digit to the right of the decimal point make no difference to the value of the number.

Example:
1.500 kg = 1.5 kg

Task 2

List these amounts of wastage in order of size on the wastage audit. Start with the lightest amount.



Wastage audit	
1st	g
2nd	g
3rd	g
4th	g
5th	g
6th	g

Tip

Think about the value of each digit.

Example:

Thousands	Hundreds	Tens	Units
1	1	5	0

Read, measure and compare weights using digital readouts.

N1/E3.1; N2/L1.4; MSS1/L1.4

PAGES 4:13–4:14

Reading gauges

Occupational setting

Learners working in many areas of manufacturing will need to be able to read and understand gauges, or simply record what gauges display. This theme develops the number and measurement skills required to read gauges accurately. Learners will need to practise these skills using the gauges in their own workplace.

Materials

A selection of different gauges, as used by learners in the workplace or at home, e.g. thermometers, tyre pressure gauges, etc.

If actual instruments are not available, find pictures of different types of gauges from the Internet or magazines.

Learning outcomes

To read gauges accurately to the nearest labelled and unlabelled division (focus page, Task 1)

Suggested teaching activities

Introduction

- Discuss different gauges that learners may have come across: car tyre pressure gauges, thermometers, fuel gauges, temperature gauges, oil-level indicators, mobile phone chargers. If possible look at some examples of these. Talk about how the information is displayed in each case, e.g. a dial with a pointer, a digital readout, LEDs, etc. Ask learners to describe the main features of gauges they use at work.
- Have a selection of photos or drawings of different types of gauge or the actual gauges; talk about what they are used for. Sort the gauges into types according to how they display information.
- Talk about what the gauges are measuring and what the units of measurement are in each case. The learners may not be familiar with some of the units. Practise measuring with the gauges if this is possible.

Focus page

- Focus on reading measurements from gauges and what you need to do to read off the values accurately.
- Point out that scales vary widely, and it is necessary to work out the value of the divisions on the scale before reading off the measurement.
- Draw attention to the calculations to determine the value of the unlabelled divisions. Check that the learners understand what has been done. Have other (graded) examples to demonstrate what needs to be done. Ask the learners to work some out individually or in a group.
- Ask learners how they would know if the volume shown on the first gauge was increasing, decreasing or not changing. What is meant by per cent? What percentage will the gauge register when the silo is full, half full, or empty? Ask if it would be possible to work out how many litres the silo contains when the reading is taken. Note that learners who do not understand per cent will need support using *Skills for Life* materials at Entry 3 and Level 1.
- Ask the same question about the pressure displayed on the second gauge. If the gauge is showing an increase, the 'needle' or pointer will move clockwise and towards larger numbers. The opposite will apply if the gauge is registering a decrease.
- Allow learners time to practise with a range of gauges if available, to ensure that they are confident with the readouts and the way gauges react to different circumstances.
- Discuss that the difference between two readings indicates the size of a change. Check here that the learners are familiar with the idea that finding the difference between two numbers is a calculation requiring subtraction. Not all learners are familiar with the different terms for 'take away' problems.
- Emphasise that to calculate the changes in the readings, the smaller reading will always be taken away from the larger reading, but it is important to remember whether the reading on the gauge is moving up or down.

Curric. refs	NOS/NVQ	Key Skills
MSS1/L1.4 Rt/L1.3	223	N1.1

Task 1

Read scales on gauges
MSS1/L1.4
Rt/L1.3

- Remind learners of the necessity of working out the value of one division on the scale.
- Remind learners of the methods used to work out the value of one division.

If the learner has difficulty

- Carry out the same exercise using greatly simplified gauges. Start with one division equalling one unit if necessary and gradually increase the complexity as the learner gains confidence.
- It will be useful to use real gauges for this task if possible.
- Dyslexic learners and those with visual discrimination difficulties may find it difficult to read numbers in very small print. Other strategies may be needed to assist this, e.g. the use of magnifying glasses.

Extension

- Use gauges that require more complex calculations to determine what one division is worth.
- Use a temperature gauge with minus numbers on it.
- Discuss with learners terms such as '45 per cent' full on the grain-store gauge.

Theme assessment

Learners should keep a record over a fixed period (e.g. one week) of a gauge used at work.

Reading gauges

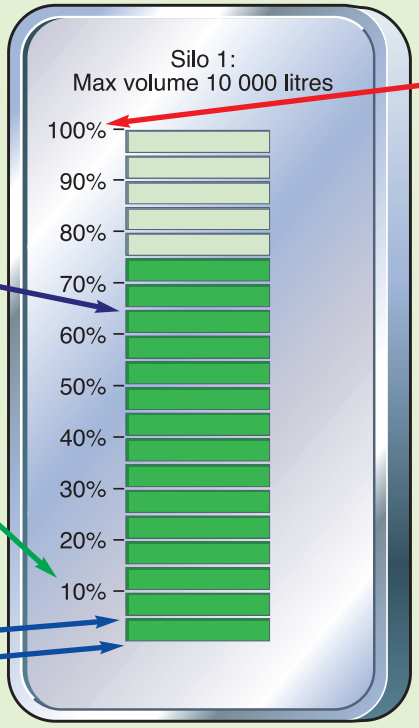
Focus

In many areas of manufacturing, measurements are read from a **gauge**.

Some gauges display information using a series of light sensors.

Tip

Before you can read the information on the gauge, you must work out the **value** of each division on the scale.



This gauge shows you the **volume** of Silo 1 as a percentage.

The scale shows **percentage** values.

Each **10%** is labelled.

Each **10%** is divided into two smaller divisions.

Each small division = **5%**
(**10** ÷ **2** = **5**)

The reading on this gauge is **75%**
(**70** + **5** = **75**)

Some gauges have a needle that points to information.

There are **5 small divisions** to each large division.

Each small division is **0.2 bar**
(**1** ÷ **5** = **0.2**)

This gauge measures in units called **bar**.

Every **2 bars** are labelled.

Each large unlabelled division is **1 bar**
(**2** ÷ **2** = **1**)

The reading on this gauge is **3.6 bar**
(**2** + **1** + **0.2** + **0.2** + **0.2** = **3.6**)

Reading gauges

Task

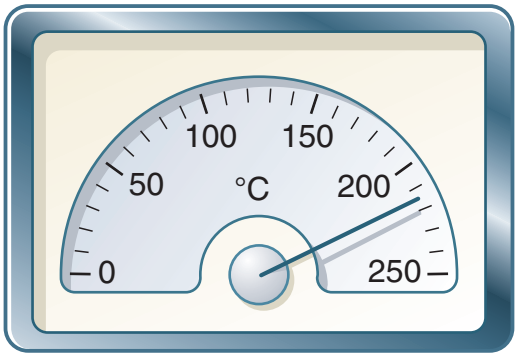
Task 1

Record the information shown on each gauge.

1

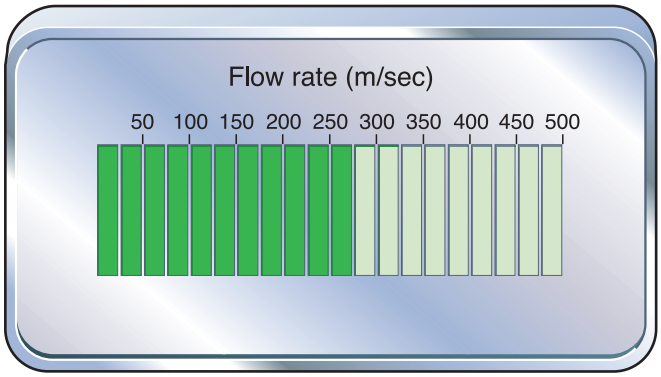
_____ rpm

2



_____ °C

3



_____ m/sec

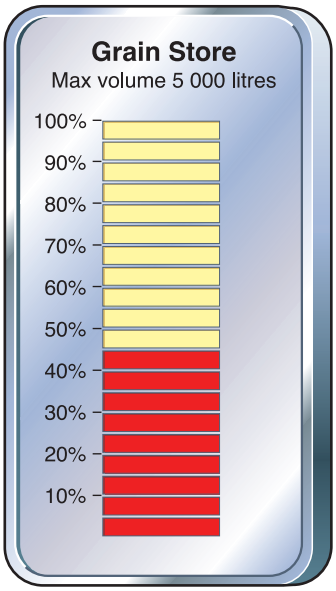
Tip

Work out the **value** of the unlabelled divisions **before** you read the gauge.

4

_____ bar

5



_____ %

Read and record measurements from different gauges.

MSS1/L1.4; Rt/L1.3

PAGES 4:15–4:16

Temperature

Occupational setting

Those involved with the manufacture of food items will need to be aware of temperature control. If further work is required, the materials for Embedded Learning on Hospitality and Catering include a module on food safety that may be useful. For other areas of manufacturing, this focus aims to explain temperature and give some practice in reading, writing and comparing temperatures.

Materials

Examples from the workplace of paperwork, visual displays, etc., where temperature is read, recorded and compared

Process check sheet from the Source material (0:38)

Learning outcomes

1 To understand the language associated with temperature (focus page)

2 To read, record and compare digital temperature (focus page, Task 3)

3 To understand positive and negative temperatures (focus page, Tasks 1 and 2)

Suggested teaching activities

Introduction

- Ask learners where temperature control is important in their workplace.
  - Have they seen temperatures being measured, or measured temperatures themselves? What instruments were used? (Examples include infra-red thermometer, digital thermometer, temperature sensor, fridge/freezer thermometer, oven thermometer, temperature probe.)
  - Where have they seen temperatures being measured, or measured temperatures (display, cooking, storage, delivery)?
- Check knowledge of vocabulary associated with scales of temperature – Celsius, Fahrenheit, centigrade and other language such as gas regulo and degrees. Confirm that Celsius is the standard used.
- What is the symbol for degrees? (º)
- Check knowledge of scales of temperature. Water always boils and freezes at the same temperature whatever the scale used to measure it, so 0°C is the same temperature as 32°F. Relate this to other uses of temperature, e.g. weather forecasting. Is it a hot day when the temperature is 30°C? What would you wear outside if the temperature was 15°C? Note: learners often have problems with the concept of minus temperatures so this should be discussed and explained thoroughly to check that learners understand what it means.
- Give everyone in the group one card with a temperature on it – some with temperatures below zero – and ask them as a group to put the temperatures in order, hottest at the top, coldest at the bottom.
- Put a green line at the zero point to show where the positive and negative temperatures begin.
- Ask the group what they notice about the numbers below zero. (They have a minus sign before the number and the number grows larger the colder it is.)
- Ask learners to name one item they work with that needs some temperature control and to say which of the temperatures in the list would be best for their item.
- Ask them what the highest temperature is; what the lowest is. Check learners' knowledge of the language of temperature – degrees, maximum, minimum, etc. To ensure that words like minimum are understood, pose questions like: *What is the maximum temperature shown here on the list? What is the minimum? If food had to be displayed at a minimum temperature of 50°C, would any of these temperatures on the list be all right? If I have a product that has a maximum storage temperature of 5°C, where can it be stored?*

- Further test the learners' concept of temperature by asking questions like: *If a chicken has an internal temperature of 82°C recorded by a probe, do you think you could burn your finger at this temperature?* (Yes! 100°C is boiling point.)

Focus page

- Spend some time getting learners to familiarise themselves with the layout of the chart.
- To start learners calculating with temperature, ask questions like, *How many degrees different is that temperature from that one? If I have a product whose maximum storage temperature is 7°C and the reading on the probe is 10°C, how much more/less is the reading than the maximum temperature?* (ESOL learners may need additional help with the words like maximum, more and less.)
- Ask learners to share how they perform the mental calculations and offer any alternative strategies not mentioned, such as counting on and counting back, subtraction or addition.
- Focus particularly on temperatures below freezing. Pose scenarios like, *If a product has a maximum temperature of minus 15°C, can it be stored at minus 18°C? Which is colder, minus 20°C or minus 13°C?*
- Ask learners to ask each other 'if' questions regarding the consequences of products getting too cold or too hot.

Curric. refs	NOS/NVQ	Key Skills
N1/L1.2	218	N1.1
MSS1/E3.9	219	N1.2
MSS1/L1.4	220	
	223	

Task 1

Read information on a temperature recording sheet
MSS1/L1.4

Look again at the form on the focus page.

If the learner has difficulty

- It may help to cover the sections not being looked at to keep distractions to a minimum. An L-shaped card might also help.
- Encourage learners to verbalise what is required on the form. Check they understand the term 'at or above'.

Extension

- Create some further situations/examples of recording sheets from the workplace.
- Introduce the concept of tolerance. Ask learners to calculate what the maximum and minimum temperature allowed would be on some realistic examples, e.g. 15 ± 2°C would be max 17°C and min 13°C.

Task 2

Read information on a temperature recording sheet
MSS1/L1.4

Check the answers from the previous task. Remind learners of minus temperatures.

If the learner has difficulty

- Ensure that the language associated with negative temperatures is understood. Check the learner understands the term 'at or below'.
- It may help to cover the sections not being looked at to keep distractions to a minimum. An L-shaped card might also help.

Extension

- Create some further situations/examples of recording sheets from the workplace.
- Ask learners to calculate what the maximum and minimum temperature allowed would be on some realistic examples, e.g. –15 ± 2°C would be max –13°C and min –17°C.

Task 3

Reading and comparing temperatures
MSS1/E3.9

Remind learners of work done on the focus page.

If the learner has difficulty

- Put each temperature on a card and ask learners to sort them. Ordering the positive numbers should not be too much of a problem, but expect there to be difficulties with the negative numbers. Ask, *Which is colder, minus 2 or minus 21?*
- Use readouts from the workplace and assist learners to arrange them from highest to lowest.
- Ask learners to copy temperatures from a digital display onto paper.

Extension

- Create a temperature line using the temperatures on the page and arrange them from highest to lowest.
- Repeat the task with workplace temperatures.

Theme assessment

Ask learners to find out where in the workplace temperature is important and to use the Process check sheet from the Source material/QA form from the workplace to set up scenarios for other learners to complete.

Temperature

Focus

It is important to check temperatures to make sure that products are in perfect condition at any stage of the production process.

When is temperature important in the production process that you are involved in?

Process check sheet

Date		Shift		Line		Key F First off I In process L Last off
Date	**Time**	**Key Code**	**Weight**	**Temp**	**Pass**	**Fail**
27/5	0730	F	405 g	19°C		

Part of the quality check in this part of the factory is to record the temperature of the product at different stages of production.

If the temperature falls below 20°C at this stage, the product fails the test.

Does it pass or fail?

Process check sheet

Date		Shift		Line		Key F First off I In process L Last off
Date	**Time**	**Key Code**	**Weight**	**Temp**	**Pass**	**Fail**
30/9	1930	L	399 g	−14°C		

In this part of the checking process, the product must not be above −15°C.

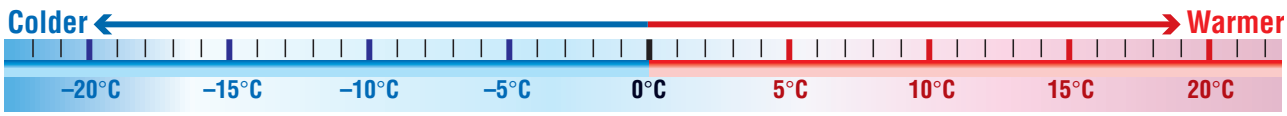
Does it pass or fail?

Understanding temperature readings

Temperatures **below zero** are written with a minus sign in front of them. They are called **negative** or **minus** temperatures.

0°C is the temperature at which water freezes.

Temperatures **above zero** do not have a minus sign in front of them. They are called **positive** temperatures.



Temperature

Task

Task 1

The temperature of this product must be **at or above 21°C**.

Which ones pass and which ones fail?

✓ Tick in the correct column.

Process check sheet

Date	Shift	Line	Key F First off I In process L Last off

Date	Time	Key Code	Weight	Temp	Pass	Fail
27/5	0730	F	402 g	19°C		✓
27/5	0800	I	399 g	21°C		
27/5	0830	I	400 g	20°C		
27/5	0900	I	401 g	22°C		
27/5	0930	L	400 g	23°C		

Task 2

The temperature of this product must be **at or below –10°C**.

Which ones pass and which ones fail?

✓ Tick in the correct column.

Process check sheet

Date	Shift	Line	Key F First off I In process L Last off

Date	Time	Key Code	Weight	Temp	Pass	Fail
29/9	1000	F	402 g	–10°C		
29/9	1030	I	399 g	–12°C		
29/9	1100	I	400 g	–9°C		
29/9	1130	I	401 g	–8°C		
29/9	1200	L	400 g	–11°C		

Task 3

Circle the highest and lowest temperatures on these readouts.

1 

2 

3 

4 

5 

6 

7 

8 

Read digital temperature.

MSS1/L1.4; MSS1/E3.9

PAGES 4:17–4:18
Finding the average

Occupational setting

During the quality control/sampling process, operatives are often asked to test a product on a number of occasions and then to find the mean or average of the results. This focus aims to explain the calculations involved in this process and give practice in using the method.

Materials

Workplace examples of calculating averages

Learning outcomes

To find the arithmetical average (mean) of a set of data (focus page, Task 1)

Suggested teaching activities

Introduction

- Ask learners about their experience of finding averages or mean numbers at work. How does this contribute to the quality process? Why is it important?
- Ask learners for their understanding of the terms. Use the terms 'average' and 'mean' together to reinforce the arithmetical meaning.
- Ask learners what is the average number of cups of coffee, tea or soft drink they drink in a day. Emphasise that while 'average' in this context could be taken to mean an estimate, the word average can be more precise and involve a calculation. So to work out the arithmetical average number of cups of coffee drunk in a day, you would need to collect data for a set period of time, perhaps a week, and use this information to calculate the average.

Focus page

- Look at the example on the focus page, showing the process for calculating an average.
- If necessary, repeat the exercise, asking learners the average/mean number of times they have been out in the evening over the last four weeks. Go through the steps in calculating this (i.e. counting up the number of times for each week, adding the results together and dividing by the number of weeks). Show the working on the board/flipchart.
- Use a calculator. Demonstrate the order in which digits should be entered to get the final answer.
- Discuss what to do if the answer is not a whole number. Are there occasions when a fraction is required? Is it sensible to round the result up, or down?
- You may need to spend a little time on the language used here, for instance the word 'average' can be placed in several different places (e.g. 'average number', 'on average', 'the average of'). The correct mathematical term is 'mean', which may cause some confusion.

Curric. refs	NOS/NVQ	Key Skills
HD1/L1.3	220 223	N1.2

Task 1

Find averages

HD1/L1.3

- Discuss how the data might have been collected – how many samples were tested, etc. Mock it up if necessary. Point out the explanation of the word viscosity on the page, so that learners understand what it means even though they can answer the questions from the table by looking for the key word.
- Make sure learners know how the data has been presented on the 'unified inspection results chart' – make sure they know to add the numbers across each row and divide by four to find the average for each part of the quality check.
- Note: learners use their answers from the chart to answer the questions on the page. This is intended to strengthen the context and so aid learners' understanding of the value of what they are doing.

If the learner has difficulty

- Some learners might find it difficult to remember the formula for finding the average. Put the simplified version of the formula from the task page on a cue card, with an example on the other side to help remind the learner.
- Check learners are adding the numbers in rows, not columns. The use of a guide card might help here. Ask them to describe what they are doing.
- Learners experiencing difficulty with addition or dividing by four will need support from *Skills for Life* materials at entry level. A calculator could be used, but check that learners know how to use this. In particular watch for correct entry of the decimal point.
- Learners may have problems matching the rows to the correct questions on the page. Give support for the reading involved here.

Extension

Add data for another four samples. Ask learners to find the average for this set of four samples, then an overall average.

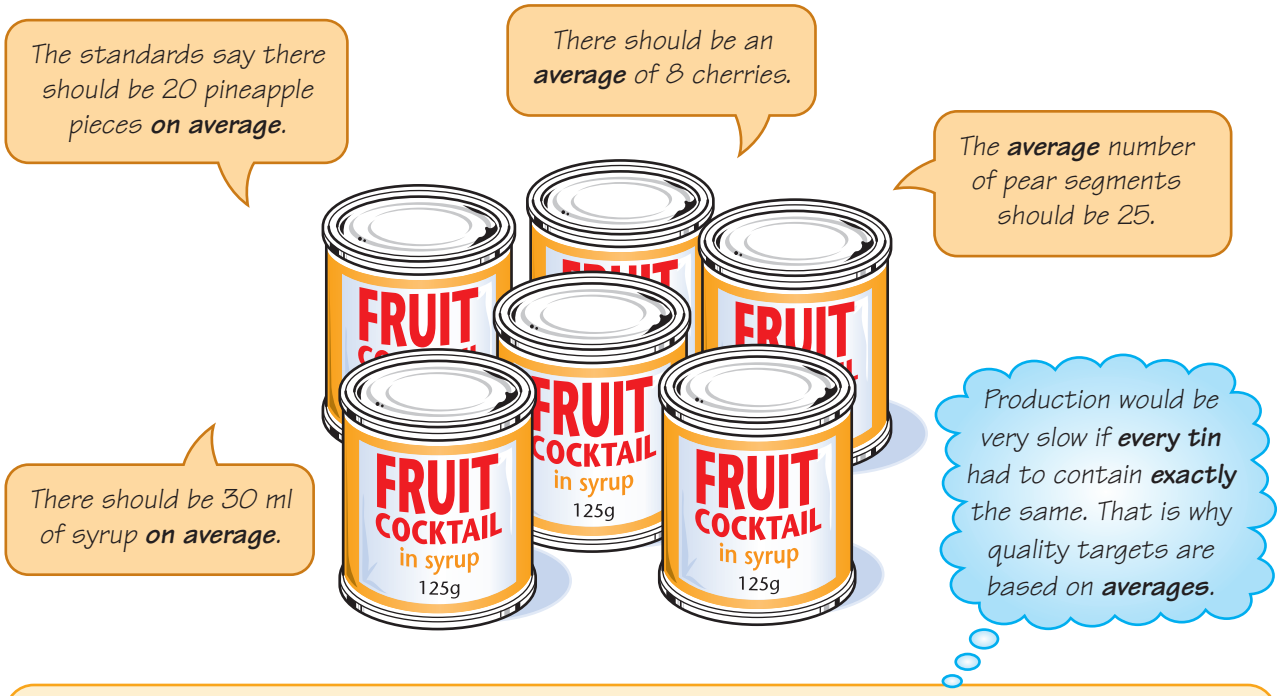
Theme assessment

Ask learners to find the average for sets of data from the workplace. This should be for any measures, including weight, temperature or length. If possible they should collect the data themselves.

Finding the average

Focus

Some quality targets are achieved if the samples taken from **several products** meet the standards.



In general terms, **average** means the '**usual**' or the '**normal**' amount.

You calculate the **arithmetical average** like this:

1 Add the amounts found in each sample.

2 Divide the total amount by the number of samples to find the average amount.

Example:

Quality check – **Fruit cocktail in syrup**
Check: **Number of pineapple pieces**
LINE: 113 TIME 09:45

Sample **1**	Sample **2**	Sample **3**	Sample **4**	Sample **5**	Sample **6**
19	20	22	21	20	18

AVERAGE: **20**

Step 1: 19 + 20 + 22 + 21 + 20 + 18 = 120

Step 2: 120 ÷ **6** = 20. The **average** number of pineapple pieces is **20**.

The **arithmetical average** is often shortened to '**average**.'
Sometimes it is called the '**mean**'.
You could say the **mean** number of pineapple pieces is 20.

Finding the average

Task

Remember!

To calculate the arithmetical average:

1 Add the data from all the samples.

2 Divide the total by the number of samples.

Remember!

Viscosity = thickness of the yoghurt.

Task 1

Use the inspection results in the table to answer the questions.

1 What is the average number of pieces of fruit? _____

2 What is the average weight of the fruit? _____ grams

3 What is the average viscosity rating of the yoghurt? _____

5 What is the average fat content? _____ grams

Unified inspection results - CREAMY & THICK STRAWBERRY YOGHURT PI No 392930F TIME 14:25					
INSP. ITEM	1st sample	2nd sample	3rd sample	4th sample	Arithmetical average
Number of fruit pieces	6	7	5	6	_____
Weight of fruit	12.5 g	13.3 g	12.1 g	13.1 g	_____ g
Viscosity rating	20	21	19	20	_____
Fat content	5.5 g	5.3 g	5.8 g	5.4 g	_____ g

PAGES 4:19–4:21

Quality checks

Occupational setting

Checking quality is a necessary part of every stage of the production process and is a necessary part of employee involvement with a product. Whilst many checks are objective, collecting quantitative data, some checks are subjective and rely on the judgement of the operative, collecting qualitative data. This focus aims to explore the use of a standard to judge by and a key for scoring a judgement. It gives more practice in using a table to record into and extract information from. At the same time it explores the vocabulary of attributes associated with particular manufactured products.

Materials

Product checklists from the workplace

An example of a manufactured item

A raspberry yoghurt

Learning outcomes

1 To consider the qualities that might be considered when checking a manufactured item (focus page, Task 2)

2 To interpret qualitative information on quality check sheets (focus page, Task 1)

Suggested teaching activities

Introduction

- Discuss the difference between the qualitative and quantitative checks that can be carried out on a manufactured product. What qualitative checks are carried out on a product learners are familiar with?
- It may be useful to remind learners about the work done in the first theme of this module: Quality control.
- Using the example of a manufactured item from the workplace, ask learners to consider what quantitative checks might have been carried out on it and list them on a flipchart.
- Note: dyslexic learners will need to be reminded of earlier work on quality control in order to help them make links to aid memory.

Focus page

- Discuss the use of the five senses and ask learners to categorise the checks listed on the flip chart. Can they think of products that may require checks for each sense? Is there any product that requires checks using all five senses?
- What describing words can be associated with each sense? (For example: smell – rancid; taste – sweet; sight – bright; feel – rough; sound – loud.)
- Consider the form on the page. Model reading it through. Pay particular attention to the key. Point out that keys may differ (the one on the task page is the other way round to the one on the focus page). Emphasise the importance of reading and using the key carefully.
- Discuss and list the attributes (like those in the specifications) of a raspberry yoghurt. (Use a real raspberry yoghurt for realism!) *What words would you use to describe it?* (creamy, smooth, pink, tasty, sweet, sweeter, sweetest, less sweet than, etc.)
- Ask learners to invent a specification for a raspberry yoghurt. Write suggestions on a flipchart.
- Model filling in the form using the specification on the flipchart.
- Note: to help learners with visual perception problems, give them a piece of card to help guide them through the table layout of the form.

Curric. refs	NOS/NVQ	Key Skills
Rw/L1.2	220	C1.1
Wt/L1.5		C1.3
HD1/L1.1		

Task 1

Read information from a quality check form
HD1/L1.1

- Ensure that learners understand the format of the table by asking questions about the headings.
- Look at the key – it is different to the one on the focus page.
- Talk about why AGR and LBW made the decisions to score the yoghurts as they did.
- Ensure that learners understand how to complete the task. There are no absolutely correct answers.
- This task is best done in pairs or as a group.

If the learner has difficulty

- Talk through the information in the speech bubbles and how each one links with the scoring, as explained in the key.
- Talk through suggestions for completing the remaining speech bubbles – ask for suggestions of words that might be used and verbalise the reason based on the models on the page. You can write the learner's responses.

Extension

Using a quality check sheet from the workplace, ask the learner to invent a similar exercise for other learners.

Task 2

Develop a quality checklist for a product that you know
Wt/L1.5

- Work through the example of the chicken and leek pie on the page. Where in the production process do the checks occur? What sorts of things will the operative be looking out for? List these on a flipchart.
- In pairs or small groups, get learners to decide on a product they will investigate.
- Explain that they will be following a similar process to the one for the chicken and leek pie, but they must make it realistic for their own product.

If the learner has difficulty

- Ensure the learner selects a product with which they are very familiar.
- Ask the learner to verbalise the checks they do in the workplace.
- Remind the learner of the production process – what checks are done by others?
- Assist with the writing.

Extension

Compile a detailed quality checklist for a product that includes both qualitative and quantitative checks.

Theme assessment

- Observe learners completing checks in the workplace.
- Use checks to provide evidence for NVQ.

Quality checks

Focus

You may be asked to do some quality checks that involve your own judgement. Depending on the product you are testing, you may be asked to:

Smell

Taste

Look

Feel

Listen

Sampling Attribute Sheet

Raw Material Creamy Raspberry yoghurt

Product code CRY/01

Put up date 23/04/06 **Use By date** 30/04/06

Test date 23/04/06 **Sample code** CRY/01/01

Key 1 = reject 2 = improvement needed 3 = meets specification

Circle score. **Use pen.**

When complete, return to Quality Assurance department.

Does the raw material match the specification?				
Appearance	Creamy pink in colour with distinct flecks of raspberry.	1	2	3
	Free from foreign bodies	1	2	3
Aroma	Distinct raspberry smell	1	2	3
	No 'off' odours	1	2	3
Flavour	Mainly raspberry with a creamy yoghurt background	1	2	3
	No taints or 'off' notes	1	2	3
Texture	Yoghurt smooth and creamy	1	2	3
	Raspberry pieces soft but distinct	1	2	3
Overall score		1	2	3
Comments				
Actions taken				

Name Paula Blair **Signature** P Blair

Information about the product

A key to tell you the meaning of each score

Instructions about how to fill out the form

A standard to judge by

Quality checks

Task

Task 1

This is part of a quality check sheet for a production line that puts four different flavoured yoghurts into pots.
Use the information that AGR and LBW have filled in on the form to fill in the speech bubbles.

Product Check Protocol

1 = good
2 = acceptable, but development to be watched closely
3 = not acceptable, immediate action to be taken

NOTE: product to be checked every 30 minutes by operator.
At shift end, all forms to be returned to collection point.

Date: 15/9/06 Shift: Day / Night Operators: AGR, LBW Flavour: 1 Prune 2 Rhubarb 3 Peach 4 Pear

Time	Date code	Seal	Lid	X Ray stat.	Taste				Filling process				Snap test OK? Y/N
					Yog1	Yog2	Yog3	Yog4	Yog1	Yog2	Yog3	Yog4	
0800	60CT	1	1	1	1	1	1	1	1	1	1	1	Y
0830	60CT	1	2	1	2	1	1	2	1	2	1	2	Y
0900	60CT	1	2	1	3	1	1	3	1	1	1	1	Y

The prune tastes a bit sour to me.

Yes. It's definitely too sour.

The pear looks a bit empty.

No. It's fine now.

a

b

c

d

Quality checks

Task

Task 2

Think about a product that you are familiar with, either at home or at work. On a separate piece of paper, make a quality specification for the product. Here are examples of the sort of things you might think about.

Tip
Don't forget to check through the five senses.

The stages in the production process:
- delivery
- assembly
- packaging
- storage
- cooking
- distribution.

Chicken	Foreign bodies
Leeks	Colour
Flour	Fat
Cream	Seasoning
Foil	Packaging

Does the chicken smell fresh?

Is the gravy too thick?

Do the leeks feel floppy?

Is there enough fill?

Is the pastry top the right colour?

Is the box damaged?

Check it

1 What is the abbreviation 'kg' short for?

A grams

B kilograms

C kegs

D pounds

Rw/E3.5

2 Which tool would you use to measure the thickness of a washer?

A metre rule

B micrometer

C voltmeter

D thermometer

MSS1/E3.8

3 This spindle is 1 m, 15 cm long. What is its measurement in mm?

A 105mm

B 1500mm

C 1015mm

D 1150mm

MSS1/L1.4

4 Which of these measurements is the longest?

A 90.012mm

B 90.102mm

C 90.120mm

D 90.001mm

N2/L1.4

Job sheet

CODE	DESCRIPTION	SPECIFICATION	TOLERANCE
AH145	Spindle	Length = 65 mm Diameter = 9 mm	± 4 mm ± 1 mm

5 Use the job sheet above to work out what is the shortest acceptable length for a spindle.

A 61mm

B 69mm

C 8mm

D 10mm

MSS1/L1.6

Monday	Tuesday	Wednesday	Thursday	Friday
7402 g	7420 g	7240 g	7204 g	7042 g

6 The table above shows the wastage for 5 days last week.
On which day was there most waste?

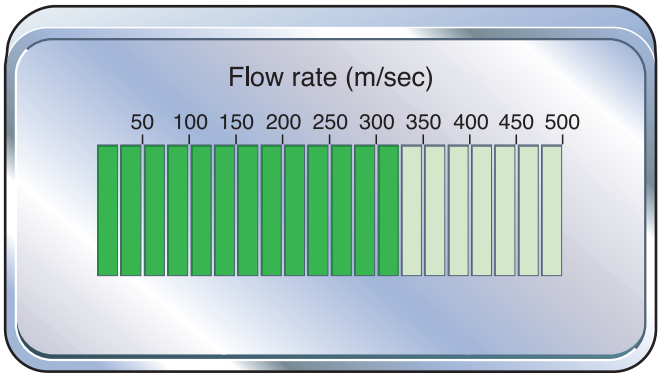
A Monday

B Tuesday

C Wednesday

D Thursday

MSS1/L1.4



7 What flow rate does this gauge show?

A 300m/sec

B 325m/sec

C 350m/sec

D 375m/sec

MSS1/L1.4

8 Which digital readout is displaying the lowest temperature?

1 

2 

3 

A 1

B 2

C 3

D 4

N1/L1.2

Unified inspection results – *Pizza/spinach/mozzarella* PI No *392930F* TIME *14:25*					
INSP. ITEM	1st sample	2nd sample	3rd sample	4th sample	Arithmetical average
Number of cheese pieces	*6*	*6*	*9*	*7*	_____

9 What is the average number of cheese pieces on the sample pizzas?

A 5

B 6

C 7

D 8 **HD1/L1.3**

Product Check Protocol

1 = good
2 = acceptable, but development to be watched closely
3 = not acceptable, immediate action to be taken

NOTE: product to be checked every 30 minutes by operator.
At shift end, all forms to be returned to collection point.

Date: 1/3/06 Shift: Day / Night Operators: OJPR NW Flavour: 1 Rasp / 2 Straw / 3 Blue / 4 Logan

Time	Date code	Seal	Lid	X Ray stat.	Taste				Filling process				Snap test OK? Y/N
					Yog1	Yog2	Yog3	Yog4	Yog1	Yog2	Yog3	Yog4	
21:00	1MAR	1	1	1	1	2	1	1	1	1	1	1	Y
21:30	1MAR	1	2	1	2	1	1	2	1	2	1	2	N
22:00	1MAR	1	2	1	3	1	1	3	1	1	1	1	Y

10 Use the Product Check Protocol form above to find out which of these statements is true.

A At nine o'clock everything was scored as 'good'.

B At half-past nine the snap test was OK.

C At 10 o'clock the lids were scored as 'not acceptable'.

D At 9.30 the filling process for the strawberry yoghurt was scored as 'acceptable, but development to be watched closely'. **HD1/L1.1**

Answers

PAGES 4:1–4:2

Quality control

Task 1

Answers should be discussed with the teacher.

Task 2

Answers should be discussed with the teacher.

PAGES 4:3–4:4

Units of measure

Task 1

1 **cl** centilitre
2 **cm** centimetre
3 **g** gram
4 **kg** kilogram
5 **kw** kilowatt
6 **l** litre
7 **mg** milligram
8 **ml** millilitre
9 **mm** millimetre
10 **V** volt

Task 2

length micrometre kilometre centimetre millimetre metre	**weight/mass** kilogram milligram gram tonne
capacity centilitre millilitre litre	**pressure** bar Pascal
	force Newton
electrical units kilowatt watt volt amp	**temperature** degrees Celsius (°C)

Task 3

1 voltmeter
2 micrometer
3 weighing scales

PAGES 4:5–4:6

Measuring length

Focus page

4 cm = 40 mm
3.5 cm = 35 mm

Task 1

FIRST-OFF PRODUCTION RUN APPROVAL
PRODUCT: MP4 Blade MACHINE: HH3

a	b	c	d
84 mm	40 mm	16 mm	60 mm

KEY
a = overall length b = overall width
c = length of non-cutting edge d = length of cutting edge

Task 2

FIRST-OFF PRODUCTION RUN APPROVAL
PRODUCT: ZB5 Washer MACHINE: K097

Time	Diameter a	Diameter b
19:18	38 mm	76 mm

KEY
Diameter a = component Diameter b = hole

PAGES 4:7–4:8

Comparing length

Task 1

1 12.500
2 12.050
3 12.505
4 12.705

Task 2

CALIBRATION CHECK

PCB GUILLOTINE
METHOD: Make cut. Check if cut length of component matches the size on the gauge. Record size difference.
Please return to QA Office when completed.

MACHINE	SIZE ON THE GAUGE	CUT SIZE OF COMPONENT	Cut size is *smaller* than gauge size by:	Cut size is *larger* than gauge size by:
DDE	50.250 mm	50.230 mm	0.020 mm	
DDF	10.500 mm	10.600 mm		0.100 mm
DDG	15.125 mm	15.120 mm	0.005 mm	
DDH	50.900 mm	50.950 mm		0.050 mm
DDJ	40.050 mm	40.550 mm		0.500 mm
DDK	91.500 mm	90.500 mm	1.000 mm	
DDL	55.750 mm	55.950 mm		0.200 mm

PAGES 4:9–4:10

Working within a tolerance

Task 1

1 67 mm
2 73 mm
3 9.5 mm
4 10.5 mm

Task 2

1 69 mm. This is acceptable.
2 75 mm. This is not acceptable.
3 73 mm. This is acceptable.
4 66 mm. This is not acceptable.

PAGES 4:11–4:12

Weighing accurately

Task 1

25 kg = 25.000 kg
20 kg = 20.000 kg
3 kg = 3.000 kg
5 kg = 5.000 kg
2 kg = 2.000 kg
15 kg = 15.000 kg
2.5 kg = 2.500 kg
1.5 kg = 1.500 kg
0.25 kg = 0.250 kg
0.2 kg = 0.200 kg
0.5 kg = 0.500 kg
0.3 kg = 0.300 kg

Task 2

Wastage audit	
1st	**115g**
2nd	**151g**
3rd	**1105g**
4th	**1150g**
5th	**1501g**
6th	**1510g**

PAGES 4:13–4:14

Reading gauges

Task 1

1 64 rpm
2 215° Celsius
3 275 m/sec
4 5.2 bar
5 45%

PAGES 4:15–4:16

Temperature

Focus page

Both temperatures shown on the Process check sheets fail.

Task 1

Temp	Pass	Fail
19°C		✓
21°C	✓	
20°C		✓
22°C	✓	
23°C	✓	

Task 2

Temp	Pass	Fail
–10°C	✓	
–12°C	✓	
–9°C		✓
–8°C		✓
–11°C	✓	

Task 3

Highest temperature = 112°C.
Lowest temperature = –21°C.

PAGES 4:17–4:18

Finding the average

Task 1

1 6
2 12.75 grams
3 20
4 5.5 grams

PAGES 4:19–4:21

Quality checks

Task 1

You may have written something like this:
a The pear tastes sweet.
b Yes there's definitely too much sugar in it.
c The rhubarb could be overfilling.
d No, it's back to normal now.

Task 2

These will depend on the product chosen. To be checked by the teacher.

Check it

1 B
2 B
3 C
4 C
5 A
6 B
7 B
8 A
9 C
10 D