

Level 3 Award in Environmental Technologies (2399)

Qualification handbook for centres



www.cityandguilds.com
September 2017
Version 6.1 September 2017

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Qualification title	Number	QAN	QW Approval / Designation No.
City & Guilds Level 3 Award in the Fundamental Principles and Requirements of Environmental Technology Systems	2399-01	600/4282/5	
City & Guilds Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems	2399-13	600/5696/4	
City & Guilds Level 3 Award in the Installation and Maintenance of Small Scale Solar Photovoltaic Systems	2399-14	600/5695/2	
City & Guilds Level 3 Award in the Installation of Solar Thermal Hot Water Systems	2399-23	600/5694/0	
City & Guilds Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems	2399-24	600/5693/9	
City & Guilds Level 3 Award in the Installation of Heat Pumps Systems (Non-refrigerant Circuits)	2399-33	600/5692/7	
City & Guilds Level 3 Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)	2399-34	600/5691/5	
City & Guilds Level 3 Award in the Installation of Water Harvesting and Re-use Systems	2399-43	600/5690/3	
City & Guilds Level 3 Award in the Installation and Maintenance of Water Harvesting and Re-use Systems	2399-44	600/5689/7	

Version and date	Change detail	Section
4.0 September 2013	Amendment to the learner pre-requisite entry requirements for 2339-13-14	Page 13 2.1 Resource requirements
3.0 May 2012	Updated to reflect new qualifications (unit 201 removed from all but 2399-01) Test specs updated	Page 3/Sections 1, 2, 4.4 and appendices
As above	Amended total number of questions and number of questions per learning outcome for Unit 311 and Unit 313	4. Assessment
2.0 January 2012	Amended Title and QAN for 2399-01	Page 3/ Section 1.0 and 1.1
1.4 Oct 2011	Amended UANs for units 341 and 342	Units
1.3 Oct 2011	Amended centre resource guidelines	Centre resource guidelines
6.1 Sep 2017	Deleted QCF	Throughout

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1 Introduction to the qualifications

This document contains the information that centres need to offer the following qualifications:

Qualification title	Number	QAN	QW Approval / Designation No.
City & Guilds Level 3 Award in the Fundamental Principles and Requirements of Environmental Technology Systems	2399-01	600/4282/5	
City & Guilds Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems	2399-13	600/5696/4	
City & Guilds Level 3 Award in the Installation and Maintenance of Small Scale Solar Photovoltaic Systems	2399-14	600/5695/2	
City & Guilds Level 3 Award in the Installation of Solar Thermal Hot Water Systems	2399-23	600/5694/0	
City & Guilds Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems	2399-24	600/5693/9	
City & Guilds Level 3 Award in the Installation of Heat Pumps Systems (Non-refrigerant Circuits)	2399-33	600/5692/7	
City & Guilds Level 3 Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)	2399-34	600/5691/5	
City & Guilds Level 3 Award in the Installation of Water Harvesting and Re-use Systems	2399-43	600/5690/3	
City & Guilds Level 3 Award in the Installation and Maintenance of Water Harvesting and Re-use Systems	2399-44	600/5689/7	

Qualification title	Number	GLH	TQT
City & Guilds Level 3 Award in the Fundamental Principles and Requirements of Environmental Technology Systems	2399-01	15	20
City & Guilds Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems	2399-13	50	60
City & Guilds Level 3 Award in the Installation and Maintenance of Small Scale Solar Photovoltaic Systems	2399-14	80	100
City & Guilds Level 3 Award in the Installation of Solar Thermal Hot Water Systems	2399-23	50	60
City & Guilds Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems	2399-24	80	100
City & Guilds Level 3 Award in the Installation of Heat Pumps Systems (Non-refrigerant Circuits)	2399-33	50	60
City & Guilds Level 3 Award in the Installation and Maintenance of Heat Pumps Systems (Non-refrigerant Circuits)	2399-34	80	100
City & Guilds Level 3 Award in the Installation of Water Harvesting and Re-use Systems	2399-43	50	60
City & Guilds Level 3 Award in the Installation and Maintenance of Water Harvesting and Re-use Systems	2399-44	80	100

This qualification meets the needs of candidates in England, Wales and Northern Ireland who want to gain a basic understanding of small scale environmental technologies to allow them to advise home owners. It allows candidates to learn, develop and demonstrate the knowledge required for employment and/or career progression in environmental technologies within the building services engineering sector.

This qualification contributes knowledge and understanding towards environmental technology systems. Once candidates have achieved this qualification they can progress onto City & Guilds qualifications providing training and assessment for specific environmental technologies. It also provides a nationally recognised qualification for environmental technologies.

Total Qualification Time

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

1.1 Qualification structures

To achieve the **City & Guilds 2399-01 Level 3 Award in the Fundamental Principles and Requirements of Environmental Technology Systems** candidates must achieve 2 credits from one mandatory unit (201).

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
K/602/3138	201	Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies	Mandatory	2

To achieve the **City & Guilds 2399-13 Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems** candidates must achieve 6 credits from two mandatory units (311, 312).

To achieve the **City & Guilds 2399-14 Level 3 Award in the Installation and Maintenance of Small Scale Solar Photovoltaic Systems** candidates must achieve 10 credits from four mandatory units (311 - 314).

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
D/602/3086	311	Know the requirements to install, commission and handover small scale solar photovoltaic systems	Mandatory	4
K/602/3088	312	Install, commission and handover small scale solar photovoltaic systems	Mandatory	2
M/602/3089	313	Know the requirements to inspect, service and maintain small scale solar photovoltaic systems	Mandatory (2399-14 only)	2
M/602/3092	314	Inspect, service and maintain small scale solar photovoltaic systems	Mandatory (2399-14 only)	2

To achieve the **City & Guilds 2399-23 Level 3 Award in the Installation of Solar Thermal Hot Water Systems** candidates must achieve 6 credits from two mandatory units (321, 322).

To achieve the **City & Guilds 2399-24 Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems** candidates must achieve 10 credits from four mandatory units (321 - 324).

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
F/602/3100	321	Know the requirements to install, commission and handover solar thermal hot water systems	Mandatory	4
L/602/3102	322	Install, commission and handover 'active' solar thermal hot water systems	Mandatory	2
Y/602/3104	323	Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems	Mandatory (2399-24 only)	2
K/602/3107	324	Inspect, service and maintain 'active' solar thermal hot water systems	Mandatory (2399-24 only)	2

To achieve the **City & Guilds 2399-33 Level 3 Award in the Installation of Heat Pump Systems (Non-refrigerant Circuits)** candidates must achieve 6 credits from two mandatory units (331, 332).

To achieve the **City & Guilds 2399-34 Level 3 Award in the Installation and maintenance of Heat Pump Systems (Non-refrigerant Circuits)** candidates must achieve 10 credits from four mandatory units (331 - 334).

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
Y/602/3054	331	Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits)	Mandatory	4
D/602/3072	332	Install commission and handover heat pump systems (non-refrigerant circuits)	Mandatory	2
F/602/3078	333	Know the requirements to inspect service and maintain heat pump system installations (non-refrigerant circuits)	Mandatory (2399-34 only)	2
L/602/3083	334	Inspect service and maintain heat pump system installations (non-refrigerant circuits)	Mandatory (2399-34 only)	2

To achieve the **City & Guilds 2399-43 Level 3 Award in the Installation of Water Harvesting and Re-use Systems** candidates must achieve 6 credits from two mandatory units (341, 342).

To achieve the **City & Guilds 2399-44 Level 3 Award in the Installation and maintenance of Water Harvesting and Re-use Systems** candidates must achieve 10 credits from four mandatory units (341 - 344).

Unit accreditation number	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
T/602/3109	341	Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems	Mandatory	4
K/602/3110	342	Install, commission and handover rainwater harvesting and greywater reuse systems	Mandatory	2
M/602/3111	343	Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems	Mandatory (2399-44 only)	2
A/602/3130	344	Inspect, service and maintain rainwater harvesting and greywater reuse systems	Mandatory (2399-44 only)	2

1.2 Opportunities for progression

On completion of each of these qualifications candidates may progress into employment or to one of the other following City & Guilds qualifications:

- 2399-13 City & Guilds Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems
- 2399-14 City & Guilds Level 3 Award in the Installation and Maintenance of Small Scale Solar Photovoltaic Systems
- 2399-23 City & Guilds Level 3 Award in the Installation of Solar Thermal Hot Water Systems
- 2399-24 City & Guilds Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems
- 2399-33 City & Guilds Level 3 Award in the Installation of Heat Pump Systems (Non-refrigerant circuits)
- 2399-34 City & Guilds Level 3 Award in the Installation and Maintenance of Heat Pump Systems (Non-refrigerant circuits)
- 2399-43 City & Guilds Level 3 Award in the Installation of Water Harvesting and Re-use Systems
- 2399-44 City & Guilds Level 3 Award in the Installation and Maintenance of Water Harvesting and Re-use Systems.

1.3 Qualification support materials

City & Guilds also provides the following publications and resources specifically for this qualification:

Description	How to access
Assignment guide for centres	www.cityandguilds.com 2399 webpage
Promotional materials information sheet	www.cityandguilds.com 2399 webpage
Handbook	www.cityandguilds.com 2399 webpage
SmartScreen	www.smartscreen.co.uk

2 Centre requirements

This section outlines the approval processes for Centres to offer this qualification and any resources that Centres will need in place to offer the qualifications including qualification-specific requirements for Centre staff.

Centres already offering City & Guilds qualifications in this subject area

All centres will need to undertake full approval for these qualifications. Centres will be approved subject to being able to demonstrate the full assessment strategy requirements and an ability to train and assess candidates to the standard of the syllabus and assessment requirements.

2.1 Resource requirements

Physical resources and site agreements

Centres must have the facilities to deliver this qualification and the ability to undertake both the practical assessments and the online assessments via City & Guilds on-line multiple-choice testing system, e-assessment.

A comprehensive list of resources centres will need to deliver this qualification can be found in Appendix 2.

Human resources

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

- be technically competent in the area in which they are delivering training and/or have experience of providing training; this knowledge must be at least to the same level as the training being delivered
- hold appropriate qualifications as detailed in this handbook.
- have recent relevant experience in the specific area they will be assessing
- be occupationally knowledgeable in the areas for which they are delivering training; this knowledge must be at least to the same level as the training being delivered
- have credible experience of providing training.

Centre staff may undertake more than one role, eg tutor and assessor or Internal Quality Assurer, but must never internally quality assure their own assessments. The specific Assessor and Internal Quality Assurer requirements, as set by the Sector Skills Council SummitSkills are detailed on the following pages.

City & Guilds Level 3 Award in the Fundamental Principles and Requirements of Environmental Technology Systems

Learner pre-requisite entry requirements

There are no specific learner prerequisite entry requirement to access this qualification; however, it is recommended that delivery centres have processes in place to confirm that learners have the potential and where applicable, relevant support to achieve the learning outcomes.

Assessor Competence Requirements

Assessors **must** have:

1. A relevant assessor qualification (A1 and A2 or TDLB D32 and D33 plus evidence of CPD to A1/A2 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm assessor competence to A1 standards.
2. Evidence of knowledge of the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies. Evidence may be in the form of a qualification or certificate issued by a recognised awarding/certification organisation or other recorded evidence to confirm sufficient knowledge for all learning outcomes contained within the unit.

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed by the Awarding Organisation as part of the quality assurance arrangements. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', Annex 2.

Internal Quality Assurers (IQA) Competence Requirements

Internal Quality Assurers **must** have a relevant Internal Quality Assurer qualification (V1 or TDLB D34 plus evidence of CPD to V1 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm Internal Quality Assurer competence to A1 standards.

The occupational competence of IQAs must be updated on a regular basis and be periodically reconfirmed by the Awarding Organisation as part of the quality assurance arrangements. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', Annex 2.

City & Guilds Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems City & Guilds Level 3 Award in the Installation and Maintenance of Small Scale Solar Photovoltaic Systems

Learner pre-requisite entry requirements

To demonstrate the prerequisite level of occupation competence required to access this qualification the learner must provide auditable evidence they have:

1. the Level 3 NVQ Diploma in Installing Electrotechnical Systems and Equipment (Buildings & Structures), **or**
2. the N/SVQ 3 Electrotechnical Services (Electrical Installation Buildings & Structures) [Those learners awarded this qualification pre 2008 must provide auditable evidence they have been awarded an accredited and regulated successful assessment certificate for BS 7671: 2008 Requirements for Electrical Installations (17th Edition)], **or**

3. auditable evidence that demonstrates they have the level of occupation competence that equates with 1 or 2 above, for example;
 - 3.1 qualification recognised by the electrical installation industry plus auditable evidence of relevant experience in the work place (e.g. Signed formal training/assessment log-book/record or employer references) plus (if not covered in the recognised qualification) auditable evidence they have been awarded an accredited and regulated successful assessment certificate for BS 7671: 2008 Requirements for Electrical Installations (17th Edition)
 - 3.2 recognition of occupational competence by a government recognised Competent Person Scheme plus auditable evidence they have been awarded an accredited and regulated successful assessment certificate for BS 7671: 2008 Requirements for Electrical Installations (17th Edition)
 - 3.3 evidence of recognition of occupational competence by the JIB/SJIB Electrical plus auditable evidence they have been awarded an accredited and regulated successful assessment certificate for BS 7671: 2008 Requirements for Electrical Installations (17th Edition).

Delivery order requirements

The units within the Level 3 Award in the Installation of Small Scale Solar Photovoltaic Systems are intended to be delivered in the following order:
ET002SPV (311), ET003SPV (312).

The units within the Level 3 Award in the Installation and maintenance of Small Scale Solar Photovoltaic Systems are intended to be delivered in the following order:
ET002SPV (311), ET003SPV (312), ET004SPV (313), ET005SPV (314) or
ET002SPV (311), ET004SPV (313), ET003SPV (312), ET005SPV (314).

Assessor Competence Requirements

Assessors **must** have:

1. A relevant assessor qualification (A1 and A2 or TDLB D32 and D33 + evidence of CPD to A1/A2 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm assessor competence to A1 standards
2. Evidence of competence in small scale solar photovoltaic systems design, installation, testing, commissioning, inspection, service and maintenance. Evidence may be in the form of a qualification or certificate issued by a recognised awarding/certification organisation or other recorded evidence to confirm technical competence that covers the knowledge and practical skill outcomes contained within the SummitSkills qualification units for small scale solar photovoltaic systems.

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', April 1020v2.1a (06.10) Annex 2.

Internal Quality Assurers (IQA) Competence Requirements

Internal Quality Assurers **must** have:

1. A relevant Internal Quality Assurer qualification (V1 or TDLB D34+ evidence of CPD to V1 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm Internal Quality Assurer competence to A1 standards
2. Building services engineering occupational experience evidenced by having a building services engineering sector related qualification at N/SVQ Level 3 or proven sector competence/experience plus access to relevant “occupational expertise” to enable them to conduct their role as Internal Quality Assurer appropriately.

The occupational competence of Internal Quality Assurers must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. Where Internal Quality Assurers have proven sector competence/experience plus access to relevant “occupational expertise” this arrangement must be quality assured by the awarding organisation. For further guidance please refer to the ‘SummitSkills Consolidated Assessment Strategy for Units and Qualifications of “Occupational Competence” in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector’, April 2010v2.1a (06.10) Annex 2.

City & Guilds Level 3 Award in the Installation of Solar Thermal Hot Water Systems **City & Guilds Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems**

Learner pre-requisite entry requirements

- N/SVQ Level 2/3 in Plumbing or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Heating and Ventilating (Domestic Installation) or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Heating and Ventilating (Industrial and Commercial Installation) or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Oil-Fired Technical Services or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Gas Installation and Maintenance or equivalent earlier certification that provides evidence of competence.

In addition, if not included in the above current certification in relation to:

- Water Regulations/Water Byelaws (WRAS or equivalent)
- Unvented Domestic Hot Water Storage Systems
- Energy Efficiency for Domestic Heating (C&G 6084 or equivalent).

Note: Stand alone Vocationally Related Qualifications (technical certificates) are not acceptable as an alternative to the NVQ awards listed above.

Delivery order requirements

The units within the Level 3 Award in the Installation of Solar Thermal Hot Water Systems are intended to be delivered in the following order:
ET002ST (321), ET003ST (322).

The units within the Level 3 Award in the Installation and Maintenance of Solar Thermal Hot Water Systems are intended to be delivered in the following order:
ET002ST (321), ET003ST (322), ET004ST (323), ET005ST (324) or
ET002ST (321), ET004ST (323), ET003ST (322), ET005ST (324).

Assessor Competence Requirements

Assessors **must** have:

1. A relevant assessor qualification (A1 and A2 or TDLB D32 and D33 + evidence of CPD to A1/A2 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm assessor competence to A1 standards
2. Evidence of competence in solar thermal hot water systems design, installation, testing, commissioning, inspection, service and maintenance. Evidence may be in the form of a qualification or certificate issued by a recognised awarding/certification organisation or other recorded evidence to confirm technical competence that covers the knowledge and practical skill outcomes contained within the SummitSkills qualification units for solar thermal hot water systems.

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', April 1020v2.1a (06.10) Annex 2.

Internal Quality Assurers (IQA) Competence Requirements

Internal Quality Assurers **must** have:

1. A relevant Internal Quality Assurer qualification (V1 or TDLB D34 and evidence of CPD to V1 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm Internal Quality Assurer competence to A1 standards
2. Building services engineering occupational experience evidenced by having a building services engineering sector related qualification at N/SVQ Level 3 or proven sector competence/experience plus access to relevant "occupational expertise" to enable them to conduct their role as Internal Quality Assurer appropriately.

The occupational competence of Internal Quality Assurers must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. Where Internal Quality Assurers have proven sector competence/experience plus access to relevant "occupational expertise" this arrangement must be quality assured by the awarding organisation. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', April 2010v2.1a (06.10) Annex 2.

City & Guilds Level 3 Award in the Installation of Heat Pump Systems (Non-refrigerant Circuits)

City & Guilds Level 3 Award in the Installation and Maintenance of Heat Pump Systems (Non-refrigerant Circuits)

Learner pre-requisite entry requirements

- N/SVQ Level 2/3 in Plumbing or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Heating and Ventilating (Domestic Installation) or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Heating and Ventilating (Industrial and Commercial Installation) or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Oil-Fired Technical Services or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Gas Installation and Maintenance or equivalent earlier certification that provides evidence of competence.

In addition, if not included in the above current certification in relation to:

- Water Regulations/Water Byelaws (WRAS or equivalent)
- Energy Efficiency for Domestic Heating (C&G 6084 or equivalent).

Note: Stand alone Vocationally Related Qualifications (technical certificates) are not acceptable as an alternative to the NVQ awards listed above.

Delivery order requirements

The units within the Level 3 Award in the Installation of Heat Pumps Systems are intended to be delivered in the following order:

ET002HP (331), ET003HP (332).

The units within the Level 3 Award in the Installation and Maintenance of Heat Pumps Systems are intended to be delivered in the following order:

ET002 HP (331), ET003HP (332), ET004HP (333), ET005HP (334) or
ET002HP (331), ET004HP (333), ET003HP (332) ET005HP (334).

Assessor Competence Requirements

Assessors **must** have:

1. A relevant assessor qualification (A1 and A2 or TDLB D32 and D33 and evidence of CPD to A1/A2 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm assessor competence to A1 standards
2. Evidence of competence in air and ground source heat pumps systems (non-refrigerant circuits) design, installation, testing, commissioning, inspection, service and maintenance. Evidence may be in the form of a qualification or certificate issued by a recognised awarding/certification organisation or other recorded evidence to confirm technical competence that covers the knowledge and practical skill outcomes contained within the SummitSkills qualification units for heat pumps systems (non-refrigerant circuits).

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', April 1020v2.1a (06.10) Annex 2.

Internal Quality Assurers (IQA) Competence Requirements

Internal Quality Assurers **must** have;

1. A relevant Internal Quality Assurer qualification (V1 or TDLB D34 and evidence of CPD to V1 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm Internal Quality Assurer competence to A1 standards
2. Building services engineering occupational experience evidenced by having a building services engineering sector related qualification at N/SVQ Level 3 or proven sector competence/experience plus access to relevant "occupational expertise" to enable them to conduct their role as Internal Quality Assurer appropriately.

The occupational competence of Internal Quality Assurers must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. Where Internal Quality Assurers have proven sector competence/experience plus access to relevant "occupational expertise" this arrangement must be quality assured by the awarding organisation. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', April 2010v2.1a (06.10) Annex 2.

City & Guilds Level 3 Award in the Installation of Water Harvesting and Re-use Systems

City & Guilds Level 3 Award in the Installation and Maintenance of Water Harvesting and Re-use Systems

Learner pre-requisite entry requirements

- N/SVQ Level 2/3 in Plumbing or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Heating and Ventilating (Domestic Installation) or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Heating and Ventilating (Industrial and Commercial Installation) or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Oil-Fired Technical Services or equivalent earlier certification that provides evidence of competence; or
- N/SVQ Level 2/3 in Gas Installation and Maintenance or equivalent earlier certification that provides evidence of competence.

In addition, if not included in the above current certification in relation to:

- Water Regulations/Water Byelaws (WRAS or equivalent).

Note: Stand alone Vocationally Related Qualifications (technical certificates) are not acceptable as an alternative to the NVQ awards listed above.

Delivery order requirements

The units within the Level 3 Award in the Installation of Water Harvesting and Recycling System are intended to be delivered in the following order:

ET002WHR (341), ET003WHR (342).

The units within the Level 3 Award in the Installation and Maintenance of Water Harvesting and Recycling System are intended to be delivered in the following order:

ET002 WHR (341), ET003WHR (342), ET004WHR (343), ET005WHR (344) or
ET002WHR (341), ET004WHR (343), ET003WHR (342), ET005WHR (344).

Assessor Competence Requirements

Assessors **must** have:

1. A relevant assessor qualification (A1 and A2 or TDLB D32 and D33 and evidence of CPD to A1/A2 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm assessor competence to A1 standards
2. Evidence of competence in water harvesting and recycling system design, installation, testing, commissioning, inspection, service and maintenance. Evidence may be in the form of a qualification or certificate issued by a recognised awarding/certification organisation or other recorded evidence to confirm technical competence that covers the knowledge and practical skill outcomes contained within the SummitSkills qualification units for water harvesting and recycling systems.

The occupational competence of assessors must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. For further guidance please refer to the 'SummitSkills Consolidated Assessment Strategy for Units and Qualifications of "Occupational Competence" in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector', April 1020v2.1a (06.10), Annex 2.

Internal Quality Assurers (IQA) Competence Requirements

Internal Quality Assurers **must** have:

1. A relevant Internal Quality Assurer qualification (V1 or TDLB D34 and evidence of CPD to V1 standards) or alternative recorded evidence, endorsed by SummitSkills to confirm Internal Quality Assurer competence to A1 standards
2. Building services engineering occupational experience evidenced by having a building services engineering sector related qualification at N/SVQ Level 3 or proven sector competence/experience plus access to relevant “occupational expertise” to enable them to conduct their role as Internal Quality Assurer appropriately.

The occupational competence of Internal Quality Assurers must be updated on a regular basis and be periodically reconfirmed by the awarding organisation as part of the quality assurance arrangements. Where Internal Quality Assurers have proven sector competence/experience plus access to relevant “occupational expertise” this arrangement must be quality assured by the awarding organisation. For further guidance please refer to the ‘SummitSkills Consolidated Assessment Strategy for Units and Qualifications of “Occupational Competence” in the Qualifications and Credit Framework (England, Northern Ireland and Wales) for the Building Services Engineering Sector’, April 2010v2.1a (06.10), Annex 2Candidate entry requirements.

Learners should not be entered for a qualification of the same type, content and level as that of a qualification they already hold.

There are no formal entry requirements for learners undertaking this qualification. However, centres must ensure that learners have the potential and opportunity to gain the qualification successfully.

Age restrictions

Learners must be 16 or over.

This qualification is not approved for use by learners under the age of 16, and City & Guilds cannot accept any registrations for learners in this age group.

3 Course design and delivery

3.1 Initial assessment and induction

Centres will need to make an initial assessment of each candidate prior to the start of their programme to ensure they are entered for an appropriate type and level of qualification.

The initial assessment should identify:

- any specific training needs the candidate has, and the support and guidance they may require when working towards their qualification. This is sometimes referred to as diagnostic testing.
- any units the candidate has already completed, or credit they have accumulated which is relevant to the qualification they are about to begin.

City & Guilds recommends that centres provide an induction programme to ensure the candidate fully understands the requirements of the qualification they will work towards, their responsibilities as a candidate, and the responsibilities of the centre. It may be helpful to record the information on a learning contract.

3.2 Recommended delivery strategies

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

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their learners
- satisfies the requirements of the qualification.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualification. This might include the following:

- literacy, language and/or numeracy
- personal learning and thinking
- personal and social development
- employability.

Where applicable, this could involve enabling the candidate to access relevant qualifications covering these skills.

For further information to assist with the planning and development of the programme, please refer to the following:

- City & Guilds 2399 qualification handbook
- SmartScreen.

4 Assessment

4.1 Summary of assessment methods

City & Guilds provides the following assessments:

- Online, on-demand testing using multiple choice questions (e-assessment)
- Practical assignments.

4.2 Time constraints

The following time constraints must be applied to the assessment of this qualification:

- Learners must be assessed within the lifespan of the qualification.
- All assessments must take no longer than the stated time limit to complete, where maximum time limits apply. Centre staff should guide learners to ensure excessive evidence gathering is avoided. Centres finding that assignments are taking longer, should contact the Qualification Consultant for guidance.
- All assessments must be completed and assessed within the candidate's period of registration. Centres should advise learners of any internal timescales for the completion and marking of individual assignments.

4.3 Evidence requirements

This qualification must be assessed using the City & Guilds set e-assessment examination.

4.4 Test specifications

The knowledge requirements will be assessed by a multiple-choice test to cover all outcomes, with approximate weightings as shown below.

Unit no: 201 (ET001)

Paper title: Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy technologies and water conservation technologies

Duration: 55 minutes

Assessment type: Multiple –Choice

Number of questions: 27

Learning Outcome	No. of questions	%
1. Know the fundamental working principles of micro-renewable energy and water conservation technologies	10	37%
2. Know the fundamental requirements of building location/building features for the potential to install micro-renewable and water conservation systems to exist	9	33%
3. Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies	4	15%
4. Know the typical advantages and disadvantages associated with micro-renewable energy and water conservation technologies	4	15%

Unit no: 311 (ET002SPV)

Paper title: Know the requirements to install, commission and handover small scale solar photovoltaic systems

Duration: 90 minutes

Assessment type: Multiple –Choice

Number of questions: 49

Learning Outcome	No. of questions	%
1. Know the health and safety risks and safe systems of work associated with solar photovoltaic system installation work	3	6%
2. Know the requirements of the relevant regulations/ standards relating to practical installation, testing and commissioning activities for solar photovoltaic system installation work	3	6%
3. Know the fundamental differences between AC and DC circuits within solar photovoltaic systems	2	4%
4. Know the purpose of solar photovoltaic system components	2	4%
5. Know the types, silicon characteristics and typical conversion efficiencies of solar photovoltaic modules	4	8%
6. Know the fundamental design principles used to determine solar photovoltaic system module array size and position requirements.	6	12%
7. Know the preparatory work required for solar photovoltaic system installation work	4	8%
8. Know the layouts and the requirements for installing solar photovoltaic module arrays	13	27%
9. Know solar photovoltaic system DC and AC circuit installation layouts within the scope of the relevant Engineering Recommendation for grid tied systems	2	4%
10. Know solar photovoltaic system protection techniques and components	2	4%
11. Know the requirements to test and commission solar photovoltaic systems	6	12%
12. Know the requirements to handover solar photovoltaic systems	2	4%

Unit no: 313 (ET004SPV)

Paper title: Know the requirements to inspect, service and maintain small scale solar photovoltaic systems

Duration: 40 minutes

Assessment type: Multiple –Choice

Number of questions: 15

Learning Outcome	No. of questions	%
1. Know the requirements for the routine inspection, service and maintenance of solar photovoltaic system installations	7	47
2. Know how to diagnose faults in solar photovoltaic system installations	5	33
3. Know how to rectify faults in solar photovoltaic systems	3	20

Unit no: 321 (ET002ST)

Paper title: Know the requirements to install, commission and handover solar thermal hot water systems

Duration: 120 minutes

Assessment type: Multiple –Choice

Number of questions: 55

Learning Outcome	No. of questions	%
1. Know the Health and Safety risks and safe systems of work associated with solar thermal hot water system installation	3	5%
2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work	3	5%
3. Know the types and layouts of solar thermal hot water system	3	5%
4. Know the purpose of components used within solar thermal hot water system installations	2	4%
5. Know the types and key operating principles of solar collectors	3	5%
6. Know the information requirements to enable system component selection and sizing	3	5%
7. Know the fundamental techniques used to select, size and position components for solar thermal hot water systems	10	18%
8. Know how the performance of solar hot water systems is measured	2	4%
9. Know the preparatory work required for solar thermal hot water system installation work	3	5%
10. Know the requirements for connecting solar thermal hot water system collector circuits to combination boiler domestic hot water circuits	2	4%
11. Know the requirements for installing solar collector arrays	5	9%
12. Know the requirements for installing for solar thermal hot water system pipework	6	11%
13. Know the requirements to test and commission solar thermal hot water system installations	8	15%
14. Know the requirements to hand over solar thermal hot water systems	2	4%

Unit no: 323 (ET004ST)

Paper title: Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems

Duration: 60 minutes

Assessment type: Multiple –Choice

Number of questions: 15

Learning Outcome	No. of questions	%
1. Know the requirements for the routine service and maintenance of 'active' solar thermal hot water systems	6	40
2. Know how to diagnose faults in 'active' solar thermal hot water system installations	5	33
3. Know how to rectify faults in 'active' solar thermal hot water system installations	4	27

Unit no: 331 (ET002HP)

Paper title: Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits)

Duration: 120 minutes

Assessment type: Multiple –Choice

Number of questions: 77

Learning Outcome	No. of questions	%
1. Know the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant circuits)	2	4%
2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for heat pump installation work	4	5%
3. Know the purpose and operational characteristics of heat pump unit and heat pump system components	5	6%
4. Know the different types of heat pump units and system arrangements for hydraulic emitter circuits	6	8%
5. Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps	24	31%
6. Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation	15	19%
7. Know the layouts of 'open loop' water filled heat pump collector circuits	1	1%
8. Know the fundamental design considerations and principles that are specific to air source heat pumps	3	4%
9. Know the preparatory work required for heat pump installation work	3	4%
10. Know the requirements to install and test heat pump systems (non-refrigerant circuits)	6	8%
11. Understand the requirements to commission heat pump system installations (non-refrigerant circuits)	4	5%
12. Understand the requirements to handover heat pump system installations	4	5%

Unit no: 333 (ET004HP)

Paper title: Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits)

Duration: 60 minutes

Assessment type: Multiple –Choice

Number of questions: 10

Learning Outcome	No. of questions	%
1. Know the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations	5	50%
2. Know how to diagnose faults in heat pump system installations	3	30%
3. Know how to rectify non-refrigerant circuit faults in heat pump system installations	2	20%

Unit no: 341 (ET002WHR)

Paper title: Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems

Duration: 90 minutes

Assessment type: Multiple –Choice

Number of questions: 47

Learning Outcome	No. of questions	%
1. Know the Health and Safety risks and safe systems of work associated with rainwater harvesting and greywater reuse system installation	2	4%
2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work	3	6%
3. Know the types and layouts of rainwater harvesting and greywater reuse system used for single premises installations	4	9%
4. Know the purpose of components used within rainwater harvesting and greywater reuse systems	2	4%
5. Know the information requirements to enable rainwater harvesting and greywater reuse system component selection and sizing	3	6%
6. Know the fundamental techniques used to select, size and position components for rainwater harvesting and greywater reuse systems	12	26%
7. Know options and requirements for the treatment of water in biological, physical, biomechanical and hybrid rainwater harvesting/greywater recycling systems	4	9%
8. Know the preparatory work required for rainwater harvesting and greywater recycling system installation work	3	6%
9. Know the requirements for installing rainwater harvesting and greywater reuse storage tanks	2	4%
10. Know the requirements for installing for rainwater harvesting and greywater recycling system pipework	3	6%
11. Know the requirements to test and commission rainwater harvesting and greywater re-use system installations	7	15%
12. Know the requirements to handover rainwater harvesting and greywater recycling systems	2	4%

Unit no: 343 (ET004WHR)

Paper title: Know the requirements to inspect, service and maintain rainwater harvesting and greywater re-use systems

Duration: 60 minutes

Assessment type: Multiple –Choice

Number of questions: 12

Learning Outcome	No. of questions	%
1. Know the requirements for the routine service and maintenance of rainwater harvesting and reuse systems	7	58%
2. Know how to diagnose faults in rainwater harvesting and greywater reuse systems	3	25%
3. Know how to rectify faults in rainwater harvesting and greywater reuse systems	2	17%

4.5 Recording forms

No recording forms are required for this qualification.

4.6 Recognition of Prior Learning (RPL)

It is strongly recommended that learners undertake all of the learning input for this qualification regardless of prior experience in this subject area. Learners may at their own risk progress straight to the examination if they feel they have sufficient experience in all aspects of the syllabus.

5 Units

Availability of units

The units for this qualification follow.

The learning outcomes and assessment criteria are also viewable on The Register of Regulated Qualifications: <http://register.ofqual.gov.uk/Unit>

Structure of units

The units in this qualification are written in a standard format and comprise the following:

- City & Guilds unit number
- Title
- SummitSkills unit reference number (in brackets)
- Level
- Credit value
- Unit Accreditation Number (UAN)
- Unit aim(s)
- Learning outcomes which are comprised of a number of assessment criteria
- Recommended Guided Learning Hours (GLH)
- Relationship to National Occupational Standards (NOS), other qualifications and frameworks
- Endorsement by a sector or other appropriate body
- Information on assessment
- Notes for guidance (if applicable).

Summary of units

City & Guilds unit number	Title	Unit number	Credits
201 (ET001)	Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies	K/602/3138	2
311 (ET002SPV)	Know the requirements to install, commission and handover small scale solar photovoltaic systems	D/602/3086	4
312 (ET003SPV)	Install, commission and handover small scale solar photovoltaic systems	K/602/3088	2
313 (ET004SPV)	Know the requirements to inspect, service and maintain small scale solar photovoltaic systems	M/602/3089	2
314 (ET005SPV)	Inspect, service and maintain small scale solar photovoltaic systems	M/602/3092	2
321 (ET002ST)	Know the requirements to install, commission and handover solar thermal hot water systems	F/602/3100	4
322 (ET003ST)	Install, commission and handover 'active' solar thermal hot water systems	L/602/3102	2

City & Guilds unit number	Title	Unit number	Credits
323 (ET004ST)	Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems	Y/602/3104	2
324 (ET005ST)	Inspect, service and maintain 'active' solar thermal hot water systems	K/602/3107	2
331 (ET002HP)	Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits)	Y/602/3054	4
332 (ET003HP)	Install commission and handover heat pump systems (non-refrigerant circuits)	D/602/3072	2
333 (ET004HP)	Know the requirements to inspect service and maintain heat pump system installations (non-refrigerant circuits)	F/602/3078	2
334 (ET005HP)	Inspect service and maintain heat pump system installations (non-refrigerant circuits)	L/602/3083	2
341 (ET002WHR)	Know the requirements to install, commission and handover rainwater harvesting and greywater reuse systems	T/602/3109	4
342 (ET003WHR)	Install, commission and handover rainwater harvesting and greywater reuse systems	K/602/3110	2
343 (ET004WHR)	Know the requirements to inspect, service and maintain rainwater harvesting and greywater reuse systems	M/602/3111	2
344 (ET005WHR)	Inspect, service and maintain rainwater harvesting and greywater reuse systems	A/602/3130	2

Unit 201

Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies (ET001)

Level: 3
Credit value: 2
UAN: K/602/3138

Unit aim

The purpose of this unit is to enable learners to develop a fundamental knowledge of micro-renewable energy and water conservation technologies. The aims of this unit are:

- to allow learners to develop the knowledge required to be able to communicate with others in relation to the fundamental working principles, potential to install and regulatory requirements for micro-renewable and water conservation technologies
- to prepare eligible learners to progress to the specialist knowledge and competence units for the installation, commissioning, handover, inspection, service and maintenance of micro-renewable energy and water conservation technologies.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will be able to:

1. Know the fundamental working principles of micro-renewable energy and water conservation technologies
2. Know the fundamental requirements of building location/building features for the potential to install micro-renewable energy and water conservation systems to exist
3. Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies
4. Know the typical advantages and disadvantages associated with micro-renewable energy and water conservation technologies

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

The learning outcomes of this unit are based upon some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Determine Legislative and Working Practice Requirements for Environmental Technology Systems EVTS 9.

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test (2399-201).

Unit 201 **Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies (ET001)**

Outcome 1 Know the fundamental working principles of micro-renewable energy and water conservation technologies

Assessment Criteria

The learner can:

1. identify the fundamental working principles for each of **heat producing micro-renewable energy technologies**
2. identify the fundamental working principles for each of **electricity producing micro-renewable energy technologies**
3. identify the fundamental working principles of **co-generation technologies**
4. identify the fundamental working principles of **water conservation technologies**.

Range

Heat producing micro-renewable energy technologies:

- Solar thermal (hot water).
- Ground source heat pump.
- Air source heat pump.
- Biomass.

Electricity producing micro-renewable energy technologies:

- Solar photovoltaic.
- Micro-wind.
- Micro-hydro.

Co-generation technologies:

- Micro-combined heat and power (heat-led).

Water conservation technologies:

- Rainwater harvesting.
- Greywater re-use.

Unit 201 **Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies (ET001)**

Outcome 2 Know the fundamental requirements of building location/building features for the potential to install micro-renewable energy and water conservation systems to exist

Assessment Criteria

The learner can:

1. clarify the fundamental requirements for the potential to install a solar water heating system to exist
2. clarify the fundamental requirements for the potential to install a solar photovoltaic system to exist
3. clarify the fundamental requirements for the potential to install a ground source heat pump system to exist
4. clarify the fundamental requirements for the potential to install an air source heat pump system to exist
5. clarify the fundamental requirements for the potential to install a biomass system to exist
6. clarify the fundamental requirements for the potential to install a micro-wind system to exist
7. clarify the fundamental requirements for the potential to install a micro-hydro system to exist
8. clarify the fundamental requirements for the potential to install a micro-combined heat and power (heat led) system to exist
9. clarify the fundamental requirements for the potential to install a rainwater harvesting/greywater re-use system to exist.

Unit 201 **Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies (ET001)**

Outcome 3 Know the fundamental regulatory requirements relating to micro-renewable energy and water conservation technologies

Assessment Criteria

The learner can:

1. confirm what would be typically classified as 'permitted development' under town and country planning regulations in relation to the deployment **technologies**
2. confirm which sections of the current building regulations/building standards apply in relation to the deployment of **technologies**.

Range

Technologies:

- Solar thermal (hot water).
- Solar photovoltaic.
- Ground source heat pump.
- Air source heat pump.
- Micro-wind.
- Biomass.
- Micro-hydro.
- Micro-combined heat and power (heat-led).
- Rainwater harvesting.
- Greywater re-use.

Unit 201 **Know the fundamental working principles, installation options and regulatory requirements for micro-renewable energy and water conservation technologies (ET001)**

Outcome 4 Know the typical advantages and disadvantages associated with micro-renewable energy and water conservation technologies

Assessment Criteria

The learner can:

1. identify typical advantages associated with each **technology**
2. identify typical disadvantages associated with each **technology**.

Range

Technology:

- Solar thermal (hot water).
- Solar photovoltaic.
- Ground source heat pump.
- Air source heat pump.
- Micro-wind.
- Biomass.
- Micro-hydro.
- Micro-combined heat and power (heat-led).
- Rainwater harvesting.
- Greywater re-use.

Unit 311

Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Level: 3
Credit value: 4
UAN: D/602/3086

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence.

The unit focuses upon the knowledge required to plan and prepare for, install (including testing and commissioning) and handover of grid connected solar photovoltaic systems that are within the scope of Engineering Recommendation G83/1 with an electrical output of up to 5 kilowatt peak (kWp) connected to both single and three-phase installations. The unit also includes fundamental design awareness and component selection outcomes but does not include detailed design.

Learning outcomes

There are **twelve** learning outcomes to this unit. The learner will:

1. Know the health and safety risks and safe systems of work associated with solar photovoltaic system installation work
2. Know the requirements of the relevant regulations/ standards relating to practical installation, testing and commissioning activities for solar photovoltaic system installation work
3. Know the fundamental differences between A.C and D.C circuits within solar photovoltaic systems
4. Know the purpose of solar photovoltaic system components
5. Know the types, silicon characteristics and typical conversion efficiencies of solar photovoltaic modules
6. Know the fundamental design principles used to determine solar photovoltaic system module array size and position requirements
7. Know the preparatory work required for solar photovoltaic system installation work
8. Know the layouts and the requirements for installing solar photovoltaic module arrays
9. Know solar photovoltaic system D.C and A.C circuit installation layouts within the scope of the relevant Engineering Recommendation for grid tied systems
10. Know solar photovoltaic system protection techniques and components
11. Know the requirements to test and commission solar photovoltaic systems
12. Know the requirements to hand over solar photovoltaic systems

Guided learning hours

It is recommended that **35** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Identify Systems, Equipment and Components [EL8]
- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant solar photovoltaic installation (within the scope of Engineering Recommendation G83/1) minimum technical competence knowledge requirements for the following schemes:

- Building Regulations Competent Person Schemes (England and Wales)
- Microgeneration Certification Scheme (MCS)
- Certifier of Construction Scheme (Scotland)

Support of the unit by a sector or other appropriate body

This unit is endorsed by SSC SummitSkills.

Assessment

This unit will be assessed by:

- An on-line multiple-choice e-assessment test.

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 1 Know the health and safety risks and safe systems of work associated with solar photovoltaic system installation work

Assessment Criteria

The learner can:

1. confirm which aspects of solar photovoltaic system installation work pose **risk**
2. confirm safe systems of work for solar photovoltaic system installation work in relation to **prevention.**

Range

Risk of:

- electrocution/electric shock
- burns
- a fall from height
- personal injury through component/equipment handling.

Prevention of:

- electrocution/electric shock
- burns
- a fall from height
- personal injury through component/equipment handling.

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 2 Know the requirements of the relevant regulations/standards relating to practical installation, testing and commissioning activities for solar photovoltaic system installation work

Assessment Criteria

The learner can:

1. interpret **building regulation/building standards** guidance as relevant to solar photovoltaic system installation work
2. interpret industry recognised **electrical wiring regulation requirements** as relevant to solar photovoltaic system installation work

Range

Building regulation/building standards in relation to:

- maintaining the structural integrity of the building
- mandating the fire resistant integrity of the building
- the prevention of moisture ingress (building watertightness)
- notification of works
- electrical safety
- system installation
- energy conservation
- inspections and testing
- commissioning

Electrical wiring regulation requirements in relation to:

- system installation
- inspection and testing
- commissioning

Unit 311 **Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)**

Outcome 3 Know the fundamental differences between A.C and D.C circuits within solar photovoltaic systems

Assessment Criteria

The learner can:

1. confirm the **fundamental differences** between A.C and D.C circuits within solar photovoltaic systems

Range

Fundamental differences:

- Voltages.
- Safe isolation.
- Selection of appropriate system components.

Unit 311 **Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)**

Outcome 4 Know the purpose of solar photovoltaic system components

Assessment Criteria

The learner can:

1. confirm the purpose of **solar photovoltaic system components**

Range

Solar photovoltaic system components:

- Photovoltaic module
- Module mounting systems
- D.C. cabling
- PV connectors
- Blocking diodes
- D.C. isolator
- D.C. fuses
- D.C. junction box
- Inverter
- A.C. isolators
- A.C. distribution board
- Generation meter
- Generation display unit
- Labels

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 5 Know the types, silicon characteristics and typical conversion efficiencies of solar photovoltaic modules

Assessment Criteria

The learner can:

1. identify the **types of solar photovoltaic module**
2. confirm the silicon characteristics of:
 - monocrystalline photovoltaic modules
 - polycrystalline/multicrystalline photovoltaic modules
 - thin film photovoltaic modules
3. state the relevant manufacturing compliance **requirements**
4. state the **typical conversion efficiencies**.

Range

Types of solar photovoltaic module:

- 'On roof' photovoltaic module
- Thin film photovoltaic module
 - silicon-based
 - non-silicon based
- 'In roof' (slate) photovoltaic module
- 'In roof' (tile) photovoltaic module
- Building integrated photovoltaic module

Requirements for:

- Crystalline type modules
- Thin film type modules

Typical conversion efficiencies associated with:

- Monocrystalline photovoltaic modules
- Polycrystalline/Multicrystalline photovoltaic modules
- Thin film photovoltaic modules

Unit 311 **Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)**

Outcome 6 Know the fundamental design principles used to determine solar photovoltaic system module array size and position requirements

Assessment Criteria

The learner can:

1. confirm the **information** required to enable solar photovoltaic array design
2. confirm how to calculate the nominal power (kWp) per m² of a given product
3. confirm how annual solar photovoltaic electrical output (kWh) can be **affected**
4. confirm the **potential effect of shading**
5. identify the potential benefit(s) of incorporating a solar tracker into the system design

Range

Information:

- Building design
- Building dimensions/angles
- Building location and orientation
- Building fabric/material details

Affected by:

- geographical irradiation levels
- the array mounting angle
- the array orientation
- over shading of the array or modules within the array

Potential effect of shading on:

- solar photovoltaic module condition
- solar photovoltaic array condition

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 7 Know the preparatory work required for solar photovoltaic system installation work

Assessment Criteria

The learner can:

1. confirm the purpose of **solar photovoltaic system components**
2. confirm the **requirements** of pre-installation checks.

Range

Solar photovoltaic system components:

- Photovoltaic module
- Module mounting systems
- D.C. cabling
- PV connectors
- blocking diodes
- D.C. isolator
- D.C. fuses
- D.C. junction box
- Inverter
- A.C. isolators
- A.C. distribution board
- Generation meter
- Generation display unit
- Labels

Requirements:

- Authorisation for the work to proceed
- Availability of appropriate access to all required work areas
- Inspection & testing of existing electrical installations
- Proposed siting of key internal system components
- Suitability of the building structure in relation to the proposed installation
- Suitability of the proposed location and position of the PV modules for optimum collection capacity
- Suitability of the building fabric in relation to the installation of the PV modules

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 8 Know the layouts and the requirements for installing solar photovoltaic module arrays

Assessment Criteria

The learner can:

1. recognise the following solar photovoltaic system module array layouts:
 - single array, single string
 - single array multiple string
2. confirm the requirements for handling, moving and storing solar photovoltaic modules
3. confirm the requirements for fixing 'on roof' solar photovoltaic modules to pitched roof slopes
4. confirm the requirements for fixing 'in roof' solar photovoltaic modules to pitched roof slopes
5. confirm the requirements for fixing solar photovoltaic modules using secondary frame structures
6. confirm the requirements for ventilation in relation solar photovoltaic modules/module arrays
7. confirm how to achieve durable weather-tightness of buildings where array cables pass through the building fabric
8. state the safety requirements that must be applied when a solar photovoltaic array has been installed prior to the installation of other system components
9. confirm the requirements for connecting solar photovoltaic modules in a single string array
10. confirm the requirements for connecting solar photovoltaic modules with multiple string array
11. confirm how to check that string voltages and currents are **suitable**
12. confirm the **requirements** for cable routing within solar photovoltaic module arrays
13. propose the correct sequence of work to minimise the risk of injury through electrocution

Range

Suitable for the:

- inverter rating
- overall system installation

Requirements:

- Avoidance of inductive loops
- Other requirements

Unit 311 **Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)**

Outcome 9 Know solar photovoltaic system D.C and A.C circuit installation layouts within the scope of the relevant Engineering Recommendation for grid tied systems

Assessment Criteria

The learner can:

1. confirm the industry approved D.C. and A.C. circuit layout for single array systems connected to single phase installations
2. confirm the industry approved D.C. and A.C. circuit layout for single array systems connected to three phase installations

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 10 Know solar photovoltaic system protection techniques and components

Assessment Criteria

The learner can:

1. confirm the **techniques and components** used to protect system and or/building
2. confirm the **techniques and components** used to protect system and or/building **users**

Range

Techniques and components:

- D.C. circuit over and under voltage protection
- D.C. circuit over and under current protection

Techniques and components (users):

- A.C. circuit over and under voltage protection
- A.C. circuit over and under frequency protection
- A.C. circuit over and under current protection

Unit 311 Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)

Outcome 11 Know the requirements to test and commission solar photovoltaic systems

Assessment Criteria

The learner can:

1. confirm the **pre-commissioning procedures and/or requirements** for a solar photovoltaic system
2. confirm the regulatory and industry pre-commissioning test requirements for the A.C. circuit within a solar photovoltaic system
3. confirm the regulatory and industry pre-commissioning test requirements for the D.C. circuit within a solar photovoltaic system
4. state the conditions that are required to implement commissioning and activities for solar photovoltaic systems
5. confirm the regulatory and industry requirements for the commissioning of the A.C. circuit within a solar photovoltaic system
6. confirm the regulatory and industry requirements for the commissioning of the D.C. circuit within a solar photovoltaic system

Range

Pre-commissioning procedures and/or requirements:

- Compliance with relevant installation instructions/regulatory requirements.
- Compliance with the system design.
- Security and integrity of system components.
- Provision of adequate ventilation for system components.
- Electrical safety.
- Electrical over-current protection arrangements

Unit 311 **Know the requirements to install, commission and handover small scale solar photovoltaic systems (ET002SPV)**

Outcome 12 Know the requirements to hand over solar photovoltaic systems

Assessment Criteria

The learner can:

1. state the pre-handover checks that need to be carried out for solar photovoltaic systems
2. confirm the recommended industry **handover procedures** for solar photovoltaic systems

Range

Handover procedures:

- Provision of written information.
- Provision of diagrammatic information.
- Provision of verbal information/demonstration relating to system operation and use

Unit 312

Install, commission and handover small scale solar photovoltaic systems (ET003SPV)

Level: 3
Credit value: 2
UAN: K/602/3088

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence. The unit focuses upon the occupational competence required to plan and prepare for, install (including testing and commissioning) and handover of grid connected solar photovoltaic systems that are within the scope of Engineering Recommendation G83/1 with an electrical output of up to 5 kilowatt peak (kWp) connected to both single and three-phase installations.

Learning outcomes

There are **five** learning outcomes to this unit. The learner will be able to:

1. Plan and prepare for the installation of a solar photovoltaic system
2. Install solar photovoltaic system components
3. Inspect and test a new solar photovoltaic system installation
4. Commission a new solar photovoltaic system installation
5. Hand over a new solar photovoltaic system installation

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been developed to reflect some of the performance requirements in the following SummitSkills National Occupational Standards:

- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant solar photovoltaic system (within the scope of Engineering Recommendation G83/1) installation minimum technical competence requirements for the following schemes:

- Building Regulations Competent Person Schemes (England and Wales)
- Microgeneration Certification Scheme (MCS)
- Certifier of Construction Scheme (Scotland)

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by a practical assignment.

Unit 312

Install, commission and handover small scale solar photovoltaic systems (ET003SPV)

Outcome 1

Plan and prepare for the installation of a solar photovoltaic system

Assessment Criteria

The learner can:

1. undertake **pre-installation checks**
2. confirm that the tools, materials and equipment required for the installation work are available and are in a safe usable condition.

Range

Pre-installation checks in relation to:

- authorisation for the work to proceed
- availability of appropriate access to all required work areas
- inspection of existing electrical installations
- proposed siting of key internal system components
- suitability of the building structure in relation to the proposed installation
- suitability of proposed location of the PV modules for optimum collection capacity
- suitability of the building fabric in relation to the installation of the PV modules.

Unit 312

Install, commission and handover small scale solar photovoltaic systems (ET003SPV)

Outcome 2

Install solar photovoltaic system components

Assessment Criteria

The learner can:

1. install a solar photovoltaic array to include as a minimum the positioning, fixing and connection of the array in accordance with
 - manufacturer's guidance
 - regulatory requirements
 - industry recognised procedures
2. install a solar photovoltaic D.C. circuit to include as a minimum the positioning, fixing and connection of **components** in accordance with
 - manufacturer's guidance
 - regulatory requirements
 - industry recognised procedures

Range

Components:

- D.C. isolator.
- Inverter.
- D.C. cabling from module(s) to D.C. isolator.
- D.C. cabling from D.C. isolator to inverter.

Unit 312

Install, commission and handover small scale solar photovoltaic systems (ET003SPV)

Outcome 3

Inspect and test a new solar photovoltaic system installation

Assessment Criteria

The learner can:

1. inspect and test the A.C. circuit in accordance with the design specification, manufacturer's requirements and the relevant regulatory requirements
2. inspect and test the D.C. circuit in accordance with the design specification, manufacturer's requirements and the relevant regulatory requirements
3. complete relevant inspection, testing and certification records in accordance with manufacturer's requirements and the relevant regulatory requirements.

Unit 312

Install, commission and handover small scale solar photovoltaic systems (ET003SPV)

Outcome 4

Commission a new solar photovoltaic system installation

Assessment Criteria

The learner can:

1. undertake relevant pre-commissioning checks in accordance with the design specification, manufacturer's requirements and the relevant regulatory requirements
2. identify the design requirements, manufacturer's requirements, client's requirements, regulatory requirements and industry requirements for the commissioning of the system
3. confirm that conditions are suitable to implement commissioning procedures
4. commission the system in accordance with design requirements, manufacturer's requirements, client's requirements, regulatory requirements and industry requirements for the commissioning of the system
5. complete relevant documentation to record the commissioning activities in accordance with manufacturer's requirements and the relevant regulatory requirements.

Unit 312

Install, commission and handover small scale solar photovoltaic systems (ET003SPV)

Outcome 5

Hand over a new solar photovoltaic system installation

The learner can:

1. undertake relevant checks to ensure that the system is ready for handover and compliant with manufacturer's guidance, regulatory requirements and industry recognised requirements
2. explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures
3. identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements
4. obtain acceptance by the end user of the system according to the industry agreed handover procedures
5. ensure that all relevant handover documentation is correctly completed and recorded in the appropriate information systems and passed to the end user in accordance with manufacturer's guidance and industry recognised procedures.

Unit 313

Know the requirements to inspect, service and maintain small scale solar photovoltaic systems (ET004SPV)

Level: 3
Credit value: 2
UAN: M/602/3089

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence. The unit focuses upon the knowledge required to inspect, service and maintain (including fault diagnosis and rectification) solar photovoltaic systems. The unit focuses upon grid connected systems that are within the scope of Engineering Recommendation G83/1 with an electrical output of up to 5 kilowatt peak (kWp) connected to both single and three-phase installations.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will be able to

1. Know the requirements for the routine inspection, service and maintenance of solar photovoltaic system installations
2. Know how to diagnose faults in solar photovoltaic system installations
3. Know how to rectify faults in solar photovoltaic systems

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5].
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6].
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7].
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8].

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC Summit Skills.

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test.

Unit 313 Know the requirements to inspect, service and maintain small scale solar photovoltaic systems (ET004SPV)

Outcome 1 Know the requirements for the routine inspection, service and maintenance of solar photovoltaic system installations

Assessment Criteria

The learner can:

1. state which documentation needs to be available to enable a routine service and maintenance inspection
2. confirm the typical routine service and maintenance **requirements**
3. confirm the recording and reporting requirements for routine maintenance work.

Range

Requirements in relation to:

- visual inspection requirements
- cleaning of components
- safe condition testing
- functional testing
- performance testing
- adjustment of controls/components.

Unit 313

Know the requirements to inspect, service and maintain small scale solar photovoltaic systems (ET004SPV)

Outcome 2

Know how to diagnose faults in solar photovoltaic system installations

Assessment Criteria

The learner can:

1. state the information that needs to be available to enable fault diagnosis
2. confirm the work action and sequences required to diagnose the following faults:
 - loss of full collection capacity
 - loss of output from inverter
 - loss of A.C. supply circuit to inverter
 - no output from D.C. circuit
 - broken or damaged solar module
 - cable failure within D.C. circuit.

Unit 313

Know the requirements to inspect, service and maintain small scale solar photovoltaic systems (ET004SPV)

Outcome 3

Know how to rectify faults in solar photovoltaic systems

Assessment Criterion

The learner can:

1. confirm the work action and sequences required to rectify the following faults:
 - loss of full collection capacity
 - loss of output from inverter
 - loss of A.C. supply circuit to inverter
 - no output from D.C. circuit
 - broken or damaged solar module
 - cable failure within D.C. circuit.

Unit 314

Inspect, service and maintain small scale solar photovoltaic systems (ET005SPV)

Level: 3
Credit value: 2
UAN: M/602/3092

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence. The unit focuses upon the occupational competence required to inspect, service and maintain (including fault diagnosis and rectification) solar photovoltaic systems. The unit focuses upon grid connected systems that are within the scope of Engineering Recommendation G83/1 with an electrical output of up to 5 kilowatt peak (kWp) connected to both single and three-phase installations.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will:

1. Undertake the routine service and maintenance of a solar photovoltaic system installation
2. Undertake fault diagnosis work on solar photovoltaic system installations
3. Undertake fault rectification work on solar photovoltaic system installations

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been developed to reflect some of the performance requirements in the following SummitSkills national occupational standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8]

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by:

- A practical assignment

Unit 314

Inspect, service and maintain small scale solar photovoltaic systems (ET005SPV)

Outcome 1

Undertake the routine service and maintenance of a solar photovoltaic system installation

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the work
2. Undertake, using safe systems of work, a visual service and maintenance inspection to include checks in relation to:
 - compliance with manufacturer's installation instructions
 - compliance with statutory regulations
 - the condition of system components
 - the correct positioning of system components
 - the security of fixing of system components
 - the provision of adequate ventilation of system components
3. Undertake using safe systems of work, routine servicing of relevant system components to include:
 - cleaning of systems components
 - checking/adjustment of system controls
4. Undertake using safe systems of work, routine service and maintenance tests to include:
 - tests required under statutory regulations
 - tests to confirm the correct operation of system safety devices
 - tests to confirm the correct operation of system controls
 - checks/actions to confirm the optimum performance of the PV array(s)
5. Complete the relevant service and maintenance records in accordance with industry recognised procedures

Unit 314

Inspect, service and maintain small scale solar photovoltaic systems (ET005SPV)

Outcome 2

Undertake fault diagnosis work on solar photovoltaic system installations

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the work
2. Identify using safe systems of work, the cause of separate **faults**
3. Agree with the relevant person(s) fault rectification procedures for the faults identified

Range

Faults:

A minimum of **FOUR** separate faults from the following list:

- loss of full collection capacity
- loss of output from inverter
- loss of A.C. supply circuit to inverter
- no output from D.C. circuit
- broken or damaged solar PV module
- cable failure within D.C. circuit

Unit 314

Inspect, service and maintain small scale solar photovoltaic systems (ET005SPV)

Outcome 3

Undertake fault rectification work on solar photovoltaic system installations

Assessment Criteria

The learner can:

1. Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work
2. Take relevant precautionary actions to minimize the risk of injury to self or others during the fault rectification work
3. Rectify, using safe systems of work separate faults
4. Undertake post-rectification tests in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures to confirm that the system is in a safe, functional and efficient condition.

Range

Faults:

A minimum of **TWO** separate faults from the following list:

- loss of full collection capacity
- loss of output from inverter
- loss of A.C. supply circuit to inverter
- no output from D.C. circuit
- broken or damaged solar PV module
- cable failure within D.C. circuit.

Unit 321

Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Level: 3
Credit value: 4
UAN: F/602/3100

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence. The unit focuses upon the knowledge required to plan and prepare for, install (including testing and commissioning) and handover of fully-filled and drainback solar thermal hot water systems. The emphasis is upon 'active' systems but the unit also includes some content relating to 'passive' systems. The unit also covers fundamental design techniques but does not cover detailed design. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area.

Learning outcomes

There are **fourteen** learning outcomes to this unit. The learner will be able to:

1. Know the Health and Safety risks and safe systems of work associated with solar thermal hot water system installation
2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work
3. Know the types and layouts of solar thermal hot water system
4. Know the purpose of components used within solar thermal hot water system installations
5. Know the types and key operating principles of solar collectors
6. Know the information requirements to enable system component selection and sizing
7. Know the fundamental techniques used to select, size and position components for solar thermal hot water systems
8. Know how the performance of solar hot water systems is measured
9. Know the preparatory work required for solar thermal hot water system installation work
10. Know the requirements for connecting solar thermal hot water system collector circuits to combination boiler domestic hot water circuits
11. Know the requirements for installing solar collector arrays
12. Know the requirements for installing for solar thermal hot water system pipework
13. Know the requirements to test and commission solar thermal hot water system installations
14. Know the requirements to hand over solar thermal hot water systems

Guided learning hours

It is recommended that **35** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Identify Systems, Equipment and Components [M8]
- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant solar thermal hot water system minimum technical competence knowledge requirements for the following schemes:

- Building Regulations Competent Person Schemes (England and Wales)
- Microgeneration Certification Scheme (MCS)
- Certifier of Construction Scheme (Scotland)

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 1 Know the Health and Safety risks and safe systems of work associated with solar thermal hot water system installation work

Assessment Criteria

The learner can:

1. confirm which aspects of solar thermal hot water system installation work pose **risk**
2. confirm **safe systems of work** for solar thermal hot water system installation work.

Range

Risk of:

- electrocution/electric shock
- burns
- toxic poisoning
- injury through flash to steam of system heat transfer fluid
- a fall from height
- personal injury through component/equipment handling.

Safe systems of work in relation to prevention of:

- electrocution/electric shock
- burns
- toxic poisoning
- injury through flash to steam of system heat transfer fluid
- a fall from height
- personal injury through component/equipment handling.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 2 Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work

Assessment Criteria

The learner can:

1. interpret building regulation/building standards guidance documentation as relevant to solar thermal hot water system installation work to identify **requirements**
2. **interpret** industry recognised water regulation/byelaw guidance documentation as relevant to solar thermal hot water system installation work.

Range

Requirements in relation to:

- maintaining the structural integrity of the building
- maintaining the fire resistant integrity of the building
- the prevention of moisture ingress (building watertightness)
- notification of work requirements
- control of temperature in primary and secondary circuits including primary circuits
- connected to unvented hot water storage systems
- energy conservation
- testing and commissioning requirements
- compliance certification.

Interpret work to identify the requirements in relation to:

- prevention of contamination of the wholesome water supply
- energy conservation
- safe operation
- testing and commissioning requirements.

Unit 321 **Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)**

Outcome 3 Know the types and layouts of solar thermal hot water system

Assessment Criteria

The learner can:

1. identify **solar thermal hot water systems** types
2. identify the solar thermal hot water system storage vessel **types and collector circuit arrangements**

Range

Solar thermal hot water systems:

- Fully filled (active)
- Drainback (active)
- Passive (thermosiphon)

Types and collector circuit arrangements:

- direct (fully filled) DHW storage cylinder only
- Indirect, sealed collector circuit, DHW storage cylinder only (solar primary coil only)
- Indirect, sealed collector circuit, DHW storage cylinder only (dual coil)
- Indirect, sealed collector circuit, pre-heat cylinder and DHW storage cylinder
- Indirect, sealed collector circuit, thermal store

Unit 321

Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 4

Know the purpose of components used within solar thermal hot water system installations

Assessment Criterion

The learner can:

1. confirm the purpose of the solar thermal hot water system **components**

Range

Components:

- differential temperature controller
- cylinder sensor(s)
- solar collector sensor
- drain back vessel
- flow meter
- flow regulator (mechanical)
- expansion vessel.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 5 Know the types and key operating principles of solar collectors

Assessment Criteria

The learner can:

1. identify the **types of solar collector**
2. confirm the **key operating principles**
3. identify the effect that the temperature difference between the solar primary circuit/collector temperature and the ambient temperature has on the relative efficiency of the **types of solar collector**

Range

Types of solar collector (1.1):

- unglazed collector
- flat plate glazed collector
- roof integrated glazed collector
- evacuated tube collector – direct flow
- evacuated tube collector – heat pipe.

Key operating principles for:

- flat plate collectors
- evacuated tube collector – direct flow
- evacuated tube collector – heat pipe.

Types of solar collector (1.3):

- unglazed collector
- flat plate glazed collector
- evacuated tube collector.

Unit 321 **Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)**

Outcome 6 Know the information requirements to enable system component selection and sizing

Assessment Criteria

The learner can:

1. confirm the information requirements in relation to:
 - building design
 - building dimensions/angles
 - building location and orientation
 - building fabric/material details
 - existing input services
 - existing hot water/heating systems
2. confirm the information requirements in relation to:
 - building occupancy
 - required hot water usage pattern.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 7 Know the fundamental techniques used to select, size and position components for solar thermal hot water systems

Assessment Criteria

The learner can:

1. confirm how to determine typical domestic hot water system **storage vessel requirements**
2. confirm how to determine typical domestic hot water system **collector area requirements**
3. confirm how to determine the annual irradiation yield as a **%(percentage) of optimum**
4. state typical recommended solar primary circuit circulation rates
5. confirm how to determine solar primary **circuit pipe size requirements**
6. confirm how to determine total solar primary circuit water content volume
7. confirm how to determine total solar primary **circuit expansion vessel size requirements**
8. identify typical sizing **requirements for drainback vessels**
9. confirm how to determine **solar primary circuit dynamic pressure drop and circulating pump size requirements.**

Range

Storage vessel requirements in relation to:

- daily demand (Vd) (litres/day per person or litres/day per m² of floor area)
- boiler volume (Vb)
- dedicated solar volume (Vs) (litres per m² of collector area or as a % of Vd)
- total cylinder volume (Vt)
- solar heat exchange coil surface area (m² of surface area in relation to collector flow rate and collector surface area).

Collector area requirements in relation to:

- building occupancy
- proposed angle of collector installation
- proposed orientation of collector installation
- Shading that may affect collector performance.

%(percentage) of optimum in relation to:

- collector orientation
- collector angle
- collector over shading.

Circuit pipe size requirements in relation to:

- primary circuit circulation rates
- collector area
- primary circuit pipework length.

Circuit expansion vessel size requirements in relation to:

- primary circuit water content volume
- collector height above cylinder.

Requirements for drainback vessels in relation to:

- net collector area
- total volume of the system.

Solar primary circuit dynamic pressure drop and circulating pump size requirements for:

- fully filled systems
- drainback systems.

Unit 321

Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 8

Know how the performance of solar hot water systems is measured

Assessment Criteria

The learner can:

1. define the meaning of the term 'solar fraction'
2. identify factors that affect the solar fraction.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 9 Know the preparatory work required for solar thermal hot water system installation work

Assessment Criteria

The learner can:

1. state the requirements in relation to:
 - authorisation for the work to proceed
 - the availability of appropriate access to all required work areas
2. confirm the requirements of **pre-installation checks**.

Range

Pre-installation checks in relation to:

- the suitability of the proposed location and position of the solar collector(s) for optimum collection capacity
- the suitability of the building structure and the building fabric in relation to the installation of system components
- verification that the generation capacity of the proposed solar hot water system installation is appropriate to the hot water system energy load and usage
- the inspection of existing hot water/heating system installations
- water quality
- the availability of a suitable electrical input service
- the proposed siting of key internal system components.

Unit 321 **Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)**

Outcome 10 Know the requirements for connecting solar thermal hot water system collector circuits to combination boiler domestic hot water circuits

Assessment Criteria

The learner can:

1. confirm how to determine the suitability of combination boilers to receive pre-heated water
2. confirm the pipework layout and components required for connecting a solar thermal hot water system to a combination boiler to include the:
 - arrangements for prevention of backflow
 - arrangements for ensuring that the combination boiler cold inlet supply water is provided at an appropriate temperature
 - arrangements for allowing stored hot water to be used directly from the store when the temperature of the stored water is appropriate

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 11 Know the requirements for installing solar collector arrays

Assessment Criteria

The learner can:

1. confirm the positioning and fixing requirements, and where appropriate, the weathering requirements for the **solar collector types**
2. confirm the pipework layout, component requirements and component positioning **requirements for the system types and collector array connection arrangements**
3. confirm the requirements to achieve durable weather-tightness of buildings where collector array connection pipework passes through the building fabric
4. state when specialist equipment is required in relation to preventing irradiation reaching collector absorbers during installation.

Range

Solar collector types:

- Flat plate, surface mounted, inclined roof with single lap roof covering.
- Flat plate, surface mounted, inclined roof with double lap roof covering.
- Flat plate, integrated, inclined single lap roof covering.
- Flat plate, integrated, inclined double lap roof covering.
- Evacuated tube, inclined single lap roof covering.
- Evacuated tube, inclined double lap roof covering.
- Frame mounted, inclined (roof, wall or ground).
- Frame mounted, horizontal (roof or ground).

Requirements for system types and collector array connection arrangements:

- Fully filled system, collector array connected in series.
- Fully filled system, collector array connected in parallel.
- Fully filled system, collector array connected with east/west split.
- Drainback system, single collector array.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 12 Know the requirements for installing for solar thermal hot water system pipework

Assessment Criteria

The learner can:

1. propose suitable **pipework materials**
2. confirm the requirements for **pipework supports**
3. state suitable **pipework jointing methods**
4. confirm the requirements for pipework insulation for solar thermal hot water system **installation work**
5. confirm the **requirements** for installing pressure relief valve discharge pipework.

Range

Pipework materials in relation to:

- system operating temperatures
- system operating pressures
- system chemicals.

Pipework supports in relation to:

- suitable materials
- spacing of pipework supports.

Pipework jointing methods in relation to:

- system operating temperatures
- system operating pressures
- system chemicals.

Installation work in relation to:

- system operating temperatures
- system efficiency and performance
- potential exposure of the insulation to ultra-violet rays/light
- potential exposure of the insulation to adverse weather
- the sections of installations that must be insulated
- the sections of installations that must not be insulated
- resistance to vermin attack.

Requirements in relation to:

- routing of pipework
- termination of pipework.

Unit 321 Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)

Outcome 13 Know the requirements to test and commission solar thermal hot water system installations

Assessment Criteria

The learner can:

1. confirm the **requirements to prepare for testing and commissioning**
2. state what specialist equipment is required in relation to:
 - the introduction and checking of system freeze protection fluids
 - setting system pressure
 - checking the corrosion protection of the system
3. confirm the testing **requirements for hydraulic circuits** within solar thermal hot water system installations
4. confirm the **commissioning requirements** for a fully-filled indirect sealed collector circuit installation
5. confirm the **commissioning requirements for a fully-filled drainback installation**
6. confirm the commissioning requirements for multiple collector arrays connected in series
7. state the recording requirements for the commissioning of solar thermal hot water system installations.

Range

Requirements to prepare for testing and commissioning in relation to:

- compliance with the system design and specification
- compliance with system/component manufacturer requirements
- suitability of electrical supply circuit arrangements
- flushing the system of installation debris
- selection of suitable heat transfer fluid
- filling and venting the hydraulic circuits
- checking system water quality
- protection against freezing
- provision of system labelling.

Requirements for hydraulic circuits in relation to:

- hydraulic test pressure
- hydraulic test duration.

Commissioning requirements in relation to:

- setting of the expansion vessel charge pressure
- setting of the system fluid level
- setting of mechanical controls
- setting of electrical controls and temperature sensors
- system functional tests.

Commissioning requirements for a fully-filled drainback installation in relation to:

- setting of the system fluid level
- setting of mechanical controls
- setting of electrical controls and temperature sensors
- system functional tests.

Unit 321 **Know the requirements to install, commission and handover solar thermal hot water systems (ET002ST)**

Outcome 14 Know the requirements to hand over solar thermal hot water systems

Assessment Criteria

The learner can:

1. confirm the pre-**handover checks** that need to be carried out
2. confirm industry handover procedures.

Range

Handover checks in relation to the:

- provision of written information
- provision of diagrammatic information
- provision of verbal information/demonstration relating to system operation and use.

Unit 322

Install, commission and handover 'active' solar thermal hot water systems (ET003ST)

Level: 3
Credit value: 2
UAN: L/602/3102

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence. The unit focuses upon the occupational competence required to plan and prepare for, install (including testing and commissioning) and handover of 'active' fully-filled and drainback solar thermal hot water systems. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will be able to:

1. Plan and prepare for the installation of 'active' solar thermal hot water system
2. Install solar thermal hot water system components
3. Test and commission an 'active' solar thermal hot water system
4. Hand over an 'active' solar thermal hot water system

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been developed to reflect some of the performance requirements in the following SummitSkills National Occupational Standards:

- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant solar thermal hot water system installation minimum technical competence requirements for the following schemes:

- Building Regulations Competent Person Schemes (England and Wales)
- Microgeneration Certification Scheme (MCS)
- Certifier of Construction Scheme (Scotland)

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by:

- A practical assignment.

Unit 322

Install, commission and handover 'active' solar thermal hot water systems (ET003ST)

Outcome 1

Plan and prepare for the installation of 'active' solar thermal hot water system

Assessment Criteria

The learner can:

1. undertake pre-installation **checks** for a solar hot water system installation
2. confirm that the tools, materials and equipment required for the installation work are available and are in a safe, usable condition.

Range

Checks relating to:

- authorisation for the work to proceed
- verification that the generation capacity of the proposed solar hot water system installation is appropriate to the hot water system load
- the availability of appropriate access to all required work areas
- the inspection of existing domestic hot water/heating system installations
- the availability of a suitable electrical input service
- the proposed siting of key internal system components
- the suitability of the building structure in relation to the proposed installation
- the suitability of the proposed location and position of the solar collector panel(s) for optimum collection capacity
- the suitability of the building fabric in relation to the installation of the solar collector panel(s).

Unit 322

Install, commission and handover 'active' solar thermal hot water systems (ET003ST)

Outcome 2

Install solar thermal hot water system components

Assessment Criterion

The learner can:

1. install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures, key system **components** on either a fully-filled or **drainback**, 'active' solar thermal hot water **system** to include as a minimum the positioning, fixing and connection of the components.

Range

Components:

Fully-filled systems:

- Solar collector.
- Expansion vessel.
- Solar circulating pump.

Drainback systems:

- Solar collector.
- Drainback vessel.
- Solar circulating pump.

Unit 322

Install, commission and handover 'active' solar thermal hot water systems (ET003ST)

Outcome 3

Test and commission an 'active' solar thermal hot water system

Assessment Criteria

The learner can:

1. prepare a fully-filled or drainback solar thermal hot water system for **testing and commissioning**
2. test the system for hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures
3. identify the commissioning **requirements** for the installation
4. commission a fully-filled or drainback system in accordance with manufacturer's guidance, design requirements, client's requirements and statutory requirements and/or industry recognised procedures
5. complete relevant documentation to record the commissioning activities.

Range

Testing and commissioning to include checks/actions to confirm:

- compliance with the system design and specification
- compliance with system/component manufacturer requirements
- the suitability of electrical supply circuit arrangements
- correct flushing the system of installation debris
- correct filling and venting the hydraulic circuits
- protection of the system against freezing
- adequate provision of system labelling.

Requirements in relation to:

- the system/component manufacturer(s) requirements
- system design/specification requirements
- the client/end user requirements
- statutory regulations and/or industry recognised procedures.

Unit 322

Install, commission and handover 'active' solar thermal hot water systems (ET003ST)

Outcome 4

Hand over an 'active' solar thermal hot water system

Assessment Criteria

The learner can:

1. undertake relevant checks to ensure that the system is ready for handover and compliant with manufacturer's guidance, the system design/specification, client's requirements, regulatory requirements and/or industry recognised requirements
2. explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures
3. identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements
4. obtain acceptance by the end user of the system according to the industry agreed handover procedures
5. ensure that all relevant handover documentation is correctly completed and recorded in the appropriate information systems and passed to the end user in accordance with manufacturer's guidance and industry recognised procedures.

Unit 323

Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems (ET004ST)

Level: 3
Credit value: 2
UAN: Y/602/3104

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence. The unit focuses upon the knowledge required to inspect, service and maintain fully-filled and drainback 'active' solar thermal hot water systems. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will:

1. Know the requirements for the routine service and maintenance of 'active' solar thermal hot water systems
2. Know how to diagnose faults in 'active' solar thermal hot water system installations
3. Know how to rectify faults in 'active' solar thermal hot water system installations

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8]

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test.

Unit 323

Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems (ET004ST)

Outcome 1

Know the requirements for the routine service and maintenance of 'active' solar thermal hot water systems

Assessment Criteria

The learner can:

1. Confirm which documentation needs to be available to enable routine service and maintenance work on 'active' solar thermal hot water systems
2. Confirm the typical routine **service and maintenance requirements for fully filled systems**
3. Confirm the typical routine **service and maintenance requirements for drainback systems**
4. Confirm the industry requirements for the recording and reporting of routine service and maintenance work on solar thermal hot water systems

Range

Service and maintenance requirements for fully filled systems in relation to:

- visual inspection requirements
- cleaning of components
- checking of system water content
- functional tests

Service and maintenance requirements for drainback systems in relation to:

- visual inspection requirements
- cleaning of components
- checking of system water content
- functional tests

Unit 323

Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems (ET004ST)

Outcome 2

Know how to diagnose faults in 'active' solar thermal hot water system installations

Assessment Criteria

The learner can:

1. Confirm the information that needs to be available to enable fault diagnosis
2. Confirm the work action and sequences required to diagnose **faults**

Range

Faults:

- loss of system pressure without evidence of discharge
- discharge from pressure relief valve on the solar primary circuit
- insulation melting on solar collector circuit pipework
- overheating of solar collector circuit
- lack of circulation within the solar collector circuit
- poor or no system performance
- system noise and/or vibration

Unit 323

Know the requirements to inspect, service and maintain 'active' solar thermal hot water systems (ET004ST)

Outcome 3

Know how to rectify faults in 'active' solar thermal hot water system installations

Assessment Criterion

The learner can:

1. Confirm the work action and sequences required to rectify **faults**

Range

Faults:

- loss of system pressure without evidence of discharge
- discharge from pressure relief valve on the solar primary circuit
- insulation melting on solar collector circuit pipework
- overheating of solar collector circuit
- lack of circulation within the solar collector circuit
- poor or no system performance
- system noise and/or vibration

Unit 324

Inspect service and maintain 'active' solar thermal hot water systems (ET005ST)

Level: 3
Credit value: 2
UAN: K/602/3107

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence. The unit focuses upon the occupational competence required to inspect, service and maintain 'active' fully-filled and drainback solar thermal hot water systems. The unit covers systems for domestic hot water production only. The unit focuses upon systems with up to 20m² of solar collector area.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will:

1. Undertake the routine service and maintenance of an 'active' solar thermal hot water system
2. Undertake fault diagnosis work on an 'active' solar thermal hot water system
3. Undertake fault rectification work on an 'active' solar thermal hot water system

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been developed to reflect some of the performance requirements in the following SummitSkills national occupational standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8]

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by:

- A practical assignment.

Unit 324

Inspect service and maintain 'active' solar thermal hot water systems (ET005ST)

Outcome 1

Undertake the routine service and maintenance of an 'active' solar thermal hot water system

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the work
2. Undertake a **visual service and maintenance inspection** of a fully-filled or drainback, 'active' solar thermal hot water system installation
3. Undertake **routine servicing of relevant components** on a fully-filled or drainback, 'active' solar thermal hot water system
4. Undertake **routine service and maintenance functional tests** on a fully-filled or drainback solar thermal hot water system
5. Complete the relevant service and maintenance records in accordance with industry recognised procedures.

Range

Visual service and maintenance inspection to include checks in relation to:

- compliance with manufacturer's installation instructions
- compliance with statutory regulations
- condition of system components including cleanliness
- correct positioning of system components
- security of fixing of system components

Routine servicing of relevant components to include:

- checking the system water levels
- checking provision for the expansion of system water
- checking for protection of the system water against freezing
- cleaning of system components
- adjustment of system controls

Routine service and maintenance functional tests to confirm:

- safe operation
- efficient operation
- the correct functioning of system components/controls

Unit 324

Inspect service and maintain 'active' solar thermal hot water systems (ET005ST)

Outcome 2

Undertake fault diagnosis work on an 'active' solar thermal hot water system

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the fault diagnosis work
2. Identify the cause of **separate faults**
3. Agree with the relevant person(s) fault rectification procedures for the faults identified

Range

A minimum of FOUR **separate faults** from the following list:

- loss of system pressure without evidence of discharge
- discharge from pressure relief valve on the solar primary circuit
- insulation melting on solar collector circuit pipework
- overheating of solar collector circuit
- lack of circulation within the solar collector circuit
- poor or no system performance
- system noise and/or vibration

Unit 324

Inspect service and maintain 'active' solar thermal hot water systems (ET005ST)

Outcome 3

Undertake fault rectification work on an 'active' solar thermal hot water system

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the fault rectification work
2. Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work
3. Take relevant precautionary actions to minimise the risk of injury to self or others during the fault rectification work
4. Rectify **separate faults**
5. Undertake post-rectification functional tests in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures to confirm that the system is in a safe, functional and efficient condition.

Range

A minimum of TWO **separate faults** from the following list:

- loss of system pressure without evidence of discharge
- discharge from pressure relief valve on the solar primary circuit
- insulation melting on solar collector circuit pipework
- overheating of solar collector circuit
- lack of circulation within the solar collector circuit
- poor or no system performance
- system noise and/or vibration

Unit 331

Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Level: 3
Credit value: 4
UAN: Y/602/3054

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence.

The unit focuses upon the knowledge required to plan and prepare for, install (including testing and commissioning) and handover of heat pump system installations.

The unit focuses upon systems up to 45kW load and include air source, water source and ground source systems. The unit covers fundamental heat pump system design awareness and component selection but does not include detailed system design.

The unit covers connection to collector loops and the fundamental requirements of collector loop design and installation; however, the unit does not cover collector loop design or installation in detail.

The unit covers the requirements for appropriate personnel competence as required by The Fluorinated Greenhouse Gases Regulations 2008, in relation to heat pump work but the unit does not cover aspects of heat pump work that involves handling fluorinated greenhouse gases or working on the heat pump refrigerant circuit.

Learning outcomes

There are **twelve** learning outcomes to this unit. The learner will:

1. Know the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant circuits)
2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for heat pump installation work
3. Know the purpose and operational characteristics of heat pump unit and heat pump system components
4. Know the different types of heat pump units and system arrangements for hydraulic emitter circuits
5. Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps
6. Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation
7. Know the layouts of 'open loop' water filled heat pump collector circuits
8. Know the fundamental design considerations and principles that are specific to air source heat pumps
9. Know the preparatory work required for heat pump installation work
10. Know the requirements to install and test heat pump systems (non-refrigerant circuits)
11. Understand the requirements to commission heat pump system installations (non-refrigerant circuits)
12. Understand the requirements to handover heat pump system installations

Guided learning hours

It is recommended that **35** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Identify Systems, Equipment and Components [M8] Plan for Environmental Technology Systems, Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant heat pump system installation (non-refrigerant circuit) minimum technical competence knowledge requirements for the following schemes:

- Building Regulations Competent Person Schemes (England and Wales)
- Microgeneration Certification Scheme (MCS)
- Certifier of Construction Scheme (Scotland)

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test.

Unit 331 **Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)**

Outcome 1 Know the health and safety risks and safe systems of work associated with heat pump system installation work (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. Confirm which aspects of heat pump installation work pose risk of:
 - electrocution/electric shock
 - burns
 - toxic poisoning personal injury though component/equipment handling
2. Confirm safe systems of work for heat pump installation work in relation to prevention of:
 - electrocution/electric shock
 - burns
 - toxic poisoning
 - personal injury though component/equipment handling

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 2 Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for heat pump installation work

Assessment Criteria

The learner can:

1. Interpret **building regulation/building standards guidance** documentation as relevant to heat pump installation work
2. Interpret **industry recognised water regulation/byelaw guidance** documentation as relevant to heat pump installation work
3. State the requirements of the current **fluorinated greenhouse gases regulations**

Range

The building regulation/building standards requirements in relation to:

- maintaining the structural integrity of the building
- maintaining the fire resistant integrity of the building
- the prevention of moisture ingress (building watertightness)
- notification of work requirements
- physical installation requirements
- energy conservation
- testing and commissioning requirements
- compliance certification

The industry recognised water regulation/byelaw requirements in relation to:

- the physical installation of the system
- energy conservation
- safe operation
- testing and commissioning requirements

Fluorinated greenhouse gases regulations in relation to:

- the competence of personnel installing heat pumps where the refrigerant circuit has been assembled and tested by the product manufacturer
- the competence of personnel installing heat pumps where the refrigerant circuit is to be assembled and tested in the location where the heat pump is to be installed and operated
- the competence of personnel undertaking leakage checking on heat pump refrigerant circuits
- the competence of personnel undertaking recovery of fluorinated greenhouse gases from heat pump refrigerant circuits

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 3 Know the purpose and operational characteristics of heat pump unit and heat pump system components

Assessment Criteria

The learner can:

1. Confirm the purpose and operational characteristics of **components**
2. Confirm how the vapour compression refrigerant circuit within a heat pump unit operates

Range

Components

- evaporator
- low pressure switch
- compressor
- high pressure switch
- condenser
- dryer/receiver
- sight glass
- expansion valve
- expansion valve phial
- refrigerant four way valve
- brine pump
- emitter circuit electromechanical valves
- fan coil
- integrated buffer tank
- ground loop heat exchanger

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 4 Know the different types of heat pump units and system arrangements for hydraulic emitter circuits

Assessment Criteria

The learner can:

1. Recognise the following **heat source/heat sink heat pump packages** that can be deployed with a hydraulic 'heat sink' emitter circuit:
2. Identify the different **types of heat pump unit** within the categories
3. Confirm the meaning of the terms:
 - monovalent system
 - bivalent system
4. Identify the **monovalent hydraulic emitter circuits**
5. Identify the **parallel bivalent hydraulic emitter circuits that incorporate a secondary heat source** other than an immersion heater:
6. Confirm the arrangements for **connecting buffer tanks**

Range

Heat source/heat sink/heat pump packages:

- outside air/water
- exhaust air/water
- brine (closed loop)/water
- water (open loop)/water
- DX (closed loop)/water

Types of heat pump unit:

- ground source – packaged (indoor)
- ground source – packaged (outdoor)
- air source - external air, packaged (indoor)
- air source - external air, packaged (outdoor)
- air source - external air, internal heat pump unit with brine circuit between fan coil unit and heat pump unit

Monovalent hydraulic emitter circuits:

- heating only
- heating with buffer tank
- heating with buffer tank and indirect stored domestic hot water
- heating with buffer tank and indirect stored domestic hot water with solar coil
- heating with thermal store

Parallel bivalent hydraulic emitter circuits that incorporate a secondary heat source

- heating with buffer tank
- heating with buffer tank and indirect stored domestic hot water
- heating with buffer tank and indirect stored domestic hot water with solar coil
- heating with buffer tank and thermal store

Connecting buffer tanks

- in series
- in parallel

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 5 Know the fundamental principles of heat pump selection and system design that are common to both air and ground source heat pumps

Assessment Criteria

The learner can:

1. Confirm the meaning of the term 'Coefficient of Performance'
2. Confirm the relationship between Coefficient of Performance and the:
 - heat pump input temperature
 - heat pump emitter temperature
3. Confirm the effect that ambient temperature can have on:
 - coefficient of performance
 - heat pump output
4. Confirm the meaning of the term 'Seasonal Performance Factor'
5. Identify the factors that can affect the Seasonal Performance Factor
6. Confirm the meaning of the term 'System Efficiency'
7. Identify the factors that can affect the 'System Efficiency'
8. Confirm why achieving minimum heat loss from the building is particularly important when designing a heat pump system
9. State the effect that oversizing of a heat pump has on:
 - system performance/efficiency
 - heat pump operation
10. State the effect that undersizing of a heat pump has on:
 - system performance/efficiency
 - heat pump operation
11. Confirm how to identify heat pump hydraulic flow rate requirements
12. Confirm how to use manufacturer's data to select heat pump units:
 - output charts
 - other data
13. Confirm the meaning of the term 'bivalent points' in relation to heat pump output charts
14. Confirm how 'bivalent points' are used to determine auxiliary heat requirements
15. Confirm how heat pump output capacity is affected by:
 - heat pump input temperature
 - heat pump output temperature
16. Identify the suitability of the following types of hydraulic heating system emitter for suitability with heat pump systems:
 - underfloor heating
 - fan assisted convector heaters
 - standard panel radiators

17. State the typical mean water temperature recommended when designing a hydraulic emitter circuit that incorporates:
 - underfloor heating
 - fan assisted convector heaters
 - standard panel radiators
18. Confirm how correction factors are used to determine panel radiator output requirements in relation to mean water temperature and room temperature difference (OC)
19. Confirm the potential benefits of including a buffer tank in the system design
20. Identify the potential disadvantages of including a buffer tank in the system design.
21. Confirm the typical allowance in litres (l) per kilowatt (kW) of heat pump output that would be allowed for sizing a buffer tank when there is no requirement for heat during compressor 'off' periods
22. Confirm using available external temperature, heat load and system flow temperature data, the required size (heat output in kW) of a heat pump to be connected to a hydraulic heat emitter circuit using a monovalent system design
23. State the typical annual operating hours for a heat pump that is being used for:
 - heating only
 - heating and domestic hot water
24. State how heat pump annual operating hours may vary in relation to the:
 - type of building
 - geographical location of the installation

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 6 Know the fundamental design principles for ground source 'closed loop' heat pump collector circuit design, component sizing and installation

Assessment Criteria

The learner can:

1. identify the **brine filled heat pump collector circuit configurations**
2. confirm the requirements of **horizontal 'closed' loop brine filled hydraulic heat pump collector circuits**
3. confirm the typical requirements of **vertical borehole 'closed' loop brine filled hydraulic heat pump collector circuits**
4. identify the **typical components**
5. confirm the **typical layout of components**
6. confirm which factors determine the year round energy available in Watts (W) per m² of ground area
7. confirm how to determine the energy requirement (refrigeration capacity) from the ground loop (kW) using the total heat pump capacity (kW) and the electrical energy input rating (kW)
8. confirm how the specific heat extraction capacity (in W/m² for horizontal/vertical trench collectors and W/m for vertical borehole collectors) of the ground collector circuit can be **affected**
9. confirm how the **total ground area (m²) requirements for horizontal collector loops is determined**
10. confirm how **the pipe length (m) requirement for a horizontal 'loop' collector circuit is determined**
11. confirm how **the pipe length (m) requirement for a 'slinky' collector circuit is determined**
12. confirm how the **typical collector length (m) requirement for a vertical borehole collector circuit is determined**
13. confirm how a **collector circuit brine pump size (Kg/h) is determined.**

Range

Brine filled heat pump collector circuit configurations:

- ground 'closed' loop horizontal
- ground 'closed' loop compact collector
- ground 'closed' loop slinky
- ground 'closed' loop vertical borehole
- lake 'closed' loop
- vertical borehole closed' loop

Horizontal 'closed' loop brine filled hydraulic heat pump collector circuits in relation to:

- suitable pipework materials
- below ground jointing
- protection against frost damage
- protection against mechanical damage
- separation distances to avoid thermal interference
- separation distances from other services and adjacent buildings
- achieving balanced loop/collector circuits

Vertical borehole 'closed' loop brine filled hydraulic heat pump collector circuits in relation to:

- suitable pipework materials
- below ground jointing
- protection against frost damage
- protection against mechanical damage
- separation distances to avoid thermal interference
- separation distances from other services and adjacent buildings
- achieving balanced loop/collector circuits

The typical components required in relation to:

- single circuit 'closed' loop collector circuits
- multi-circuit 'closed' loop collector circuits
- brine circuits between outside air source units and internal heat pump units

The typical layout of components in relation to:

- single circuit collector circuits
- multi-circuit collector circuits
- brine circuits between outside air source units and internal heat pump units

Affected by the:

- ground conditions/soil types
- type of backfill material
- geographical location – ground rest temperature
- ground loop configuration
- annual heat pump operating hours

The total ground area (m²) requirement for horizontal collector loops is determined using the following data:

- refrigeration capacity (kW)
- specific extraction output (W/m²)

Pipe length (m) requirement for a horizontal 'loop' collector circuit is determined using the following data:

- total ground area (m²)
- collector loop pipe spacing (m)

Pipe length (m) requirement for a 'slinky' collector circuit is determined using the following data:

- total ground area (m²)
- centre to centre spacing of the slinky collector (m)

The typical collector length (m) requirement for a vertical borehole collector circuit is determined using the following data:

- heat pump refrigeration capacity (kW)
- ground condition
- annual heat pump operating hours

A collector circuit brine pump size (Kg/h) is determined using the following data:

- design flow rate
- brine viscosity
- heat pump refrigeration capacity (kW)
- specific thermal capacity of brine (kJ/kg)
- temperature difference between brine circuit flow and return pipework (°C)

Unit 331 **Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)**

Outcome 7 Know the layouts of 'open loop' water filled heat pump collector circuits

Assessment Criterion

The learner can:

1. identify the **'open loop' water filled heat pump collector circuit configurations**

Range

'Open loop' water filled heat pump collector circuit configurations:

- ground 'open' loop vertical borehole
- lake 'open' loop

Unit 331 **Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)**

Outcome 8 Know the fundamental design considerations and principles that are specific to air source heat pumps

Assessment Criteria

The learner can:

1. identify the factors that need to be considered when **selecting and positioning air source heat pump fan coil units**
2. identify the design options to provide for the defrost cycle for an air source heat pump
3. confirm how to size a buffer tank to provide for an air source heat pump defrost cycle

Range

Selecting and positioning air source heat pump fan coil units in relation to:

- operating noise (including the potential effect on neighbouring properties)
- air turbulence during operation

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 9 Know the preparatory work required for heat pump installation work

Assessment Criteria

The learner can:

1. confirm the common **requirements** of pre-installation checks for air or ground source heat pump unit installations connected to hydraulic emitters circuits
2. confirm the pre-installation checks that are specific to the positioning of fan coil units

Range

Requirements in relation to:

- authorisation for the work to proceed
- the availability and collation of all relevant information
- verification of the suitability of the hydraulic emitter circuit for connection to the heat pump unit
- verification that the heat output capacity of the heat pump unit is matched to the required proportional contribution of the total building heat load
- verification that the buffer tank sizing correct
- the availability of appropriate access to all required work areas
- the availability and condition of a suitable electrical input service
- adequate provision for the siting of key internal system components
- the suitability of the building structure in relation to the proposed installation

Unit 331 **Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)**

Outcome 10 Know the requirements to install and test heat pump systems (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. confirm the requirements for moving and handling heat pump units to avoid damage to the unit
2. confirm the requirements to avoid undue noise and/or vibration transmission from the heat pump unit to the building structure during the operation of the heat pump
3. identify the **requirements** where brine circuit pipework passes through the external building fabric
4. confirm the **charging and flushing requirements** for closed loop collector circuits
5. state what equipment is needed for system charging and flushing
6. confirm the hydraulic test requirements for:
 - closed loop collector circuits
 - hydraulic emitter circuits

Range

Requirements in relation to:

- provision for movement
- protection against freezing
- prevention of water ingress

Charging and flushing requirements in relation to:

- purging of air and installation debris
- addition of antifreeze protection and suitable biocides
- checking flow rates

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 11 Understand the requirements to commission heat pump system installations (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. confirm the conditions that are required to implement commissioning activities for ground source heat pump systems
2. confirm the **commissioning requirements for ground source heat pump systems**
3. confirm the conditions that are required to implement commissioning activities for air source heat pump systems
4. confirm the **commissioning requirements for air source heat pump systems.**

Range

Commissioning requirements for ground source heat pump systems in relation to:

- setting of mechanical controls
- setting of electrical controls and temperature sensors
- functional tests

Commissioning requirements for air source heat pump systems in relation to:

- setting of mechanical controls
- setting of electrical controls and temperature sensors
- functional tests

Unit 331 Know the requirements to install commission and handover heat pump systems (non-refrigerant circuits) (ET002HP)

Outcome 12 Understand the requirements to handover heat pump system installations

Assessment Criteria

The learner can:

1. confirm the **pre-handover checks** that need to be carried out for an ground source heat pump system installation
2. confirm **the industry handover procedures** for an ground source heat pump system installation
3. confirm the pre-handover checks that need to be carried out for an air source heat pump system installation
4. confirm the industry handover procedures for an air source heat pump system installation.

Range

Pre-handover checks in relation to the:

- provision of written information
- provision of diagrammatic information
- provision of verbal information/demonstration relating to system operation and use

Industry handover procedures in relation to the:

- provision of written information
- provision of diagrammatic information
- provision of verbal information/demonstration relating to system operation and use

Unit 332

Install, commission and handover heat pumps (non-refrigerant circuits) (ET003HP)

Level: 3
Credit value: 2
UAN: D/602/3072

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence. The unit focuses upon the occupational competence required to plan and prepare for, install (including testing and commissioning) and handover of heat pump system installations. The unit focuses upon systems up to 45kW load and includes air source and ground source systems. The unit does not cover aspects of heat pump system installation work that involves handling fluorinated greenhouse gases or working on the heat pump refrigerant circuit.

Learning outcomes

There are **five** learning outcomes to this unit. The learner will:

1. Plan and prepare for the installation of heat pumps (non-refrigerant circuits)
2. Install air and ground source heat pump units (non-refrigerant circuits)
3. Test and commission a ground source heat pump installation (non-refrigerant circuits)
4. Test and commission an air source heat pump installation (non-refrigerant circuits)
5. Hand over an air or ground source heat pump installation

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been developed to reflect some of the performance requirements in the following SummitSkills national occupational standards:

- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant heat pump system installation (non-refrigerant circuit) minimum technical competence requirements for the following schemes:

- Building Regulations Competent Person Schemes (England and Wales)
- Microgeneration Certification Scheme (MCS)
- Certifier of Construction Scheme (Scotland)

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by a practical assignment.

Unit 332 Install, commission and handover heat pumps (non-refrigerant circuits) (ET003HP)

Outcome 1 Plan and prepare for the installation of heat pumps (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. Undertake **pre-installation checks** for a heat pump installation
2. Confirm that the tools, materials and equipment required for the installation work are available and are in a safe usable condition.

Range

Pre-installation checks relating to:

- authorisation for the work to proceed
- the availability of appropriate access to all required work areas
- the availability and collation of all relevant information
- verification of the suitability of the proposed location of the fan coil unit (air source heat pumps only)
- verification that the collector circuit is appropriate to the heat pump rating (ground source heat pumps only)
- verification that the heat pump rating is suitable for the emitter circuit load (heating and/or heating and hot water)
- verification of the suitability of the proposed location of the heat pump unit
- verification that the emitter circuit design or existing installation is compatible with the proposed heat pump installation.
- verification that the buffer tank size (where relevant) is appropriate
- verification of the suitability of the availability of a suitable electrical input service
- the proposed siting of key internal system components
- the suitability of the building structure in relation to the proposed installation

Unit 332 Install, commission and handover heat pumps (non-refrigerant circuits) (ET003HP)

Outcome 2 Install air and ground source heat pump units (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. Install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures an air source heat pump to include as a minimum the connection of the heat pump unit to the hydraulic emitter circuit
2. Install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures a ground source heat pump to include as a minimum the connection of the heat pump unit to the collector circuit

Unit 332 Install, commission and handover heat pumps (non-refrigerant circuits) (ET003HP)

Outcome 3 Test and commission a ground source heat pump installation (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. Prepare a ground source heat pump system for testing and commissioning to include **checks/actions**
2. Test the collector circuit for hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures
3. Identify the **commissioning requirements** for the installation
4. Commission the installation in accordance with manufacturer's guidance, design requirements, client's requirements and statutory requirements and/or industry recognised procedures
5. Complete relevant documentation to record the commissioning activities

Range

Checks/actions to confirm:

- compliance with the system design and specification
- compliance with system/component manufacturer requirements
- the suitability of electrical supply circuit arrangements
- correct flushing the system of installation debris
- correct filling and venting the hydraulic circuits
- protection of the system against freezing

Commissioning requirements in relation to:

- the system/component manufacturer(s) requirements
- system design/specification requirements
- the client/end user requirements
- statutory regulations and/or industry recognised procedures

Unit 332 Install, commission and handover heat pumps (non-refrigerant circuits) (ET003HP)

Outcome 4 Test and commission an air source heat pump installation (non-refrigerant circuits)

Assessment Criteria

The learner can:

1. Prepare an air source heat pump system for testing and commissioning to include **checks/actions**
2. Identify the **commissioning requirements for the installation**
3. Commission the installation in accordance with manufacturer's guidance, design requirements, client's requirements and statutory requirements and/or industry recognised procedures

Range

Checks/actions to confirm:

- compliance with the system design and specification
- compliance with system/component manufacturer requirements
- the suitability of electrical supply circuit arrangements
- correct flushing the system of installation debris
- correct filling and venting the hydraulic circuits
- protection of the system against freezing

Commissioning requirements for the installation in relation to:

- the system/component manufacturer(s) requirements
- system design/specification requirements
- the client/end user requirements
- statutory regulations and/or industry recognised procedures

Unit 332 Install, commission and handover heat pumps (non-refrigerant circuits) (ET003HP)

Outcome 5 Hand over an air or ground source heat pump
installation

Assessment Criteria

The learner can:

1. Undertake relevant checks to ensure that the system is ready for handover and compliant with manufacturer's guidance, the system design/specification, client's requirements, regulatory requirements and/or industry recognised requirements
2. Explain and demonstrate to the end user the operation and use of the system using manufacturer's guidance and industry agreed handover procedures
3. Identify and explain to the end user any aspects of the system that varies from the agreed specifications and requirements
4. Obtain acceptance by the end user of the system according to the industry agreed handover procedures
5. Ensure that all relevant handover documentation is correctly completed and recorded in the appropriate information systems and passed to the end user in accordance with manufacturer's guidance and industry recognised procedures

Unit 333

Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits) (ET004HP)

Level: 3
Credit value: 2
UAN: F/602/3078

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence. The aim of this unit is to allow learners to develop the knowledge required to inspect, service and maintain heat pump system installations. The unit focuses upon systems up to 45kW load and include air source and ground source systems. The unit does not cover aspects of heat pump service and maintenance work that involves handling fluorinated greenhouse gases or working on the heat pump refrigerant circuit.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will:

1. Know the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations
2. Know how to diagnose faults in heat pump system installations
3. Know how to rectify non-refrigerant circuit faults in heat pump system installations

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Component [EVTS 5]

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test.

Unit 333 Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits) (ET004HP)

Outcome 1 Know the requirements for the non-refrigerant circuit routine service and maintenance of heat pump system installations

Assessment Criteria

The learner can:

1. Confirm which documentation needs to be available to enable **routine service and maintenance work on heat pump system installations**
2. Confirm typical routine **service and maintenance requirements for an air source heat pump installation in relation to:**
3. Confirm typical routine service and maintenance requirements for a ground source heat pump installation in relation to:
4. Confirm the industry requirements for the recording and reporting of routine service and maintenance work on heat pump system installations
5. State the action(s) to take in the event of a failure or suspected failure of the refrigerant circuit and/or a suspected refrigerant circuit defect.

Range

Routine service and maintenance work on heat pump system installation in relation to:

- visual inspection requirements
- cleaning of components
- checking of system water content
- functional tests

Service and maintenance requirements for an air source heat pump installation in relation to:

- visual inspection requirements
- cleaning of components
- checking of system water content
- functional tests

Unit 333

Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits) (ET004HP)

Outcome 2

Know how to diagnose faults in heat pump system installations

Assessment Criteria

The learner can:

1. Confirm the information that needs to be available to enable fault diagnosis
2. Confirm the work action and sequences required to **diagnose faults**

Range

Diagnose faults:

- heat pump low pressure trip/alarm activated by a collector circuit malfunction
- heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- poor or no collector circuit performance
- Insufficient heat output to emitter circuit
- domestic hot water heat up is satisfactory but space heating is not operating
- system noise and/or vibration

Unit 333

Know the requirements to inspect, service and maintain heat pump system installations (non-refrigerant circuits) (ET004HP)

Outcome 3

Know how to rectify non-refrigerant circuit faults in heat pump system installations

Assessment Criterion

The learner can:

1. Confirm the work action and sequences required to **rectify faults**

Range

Rectify faults:

- heat pump low pressure trip/alarm activated by a collector circuit malfunction
- heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- poor or no collector circuit performance
- Insufficient heat output to emitter circuit
- domestic hot water heat up is satisfactory but space heating is not operating
- system noise and/or vibration

Unit 334

Inspect, service and maintain heat pump installations (non-refrigerant circuits) (ET0005HP)

Level: 3
Credit value: 2
UAN: L/602/3083

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence. The unit focuses upon the occupational competence required to inspect, service and maintain air and ground source heat pump system installations. The unit focuses upon systems up to 45kW load. The unit does not cover aspects of heat pump service and maintenance work that involves handling fluorinated greenhouse gases or working on the heat pump refrigerant circuit.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. Undertake the non-refrigerant circuit routine service and maintenance of an air source heat pump system installation
2. Undertake the non-refrigerant circuit routine service and maintenance of an ground source heat pump system installation
3. Undertake non-refrigerant circuit fault diagnosis work on an air or ground source heat pump system installation
4. Undertake non-refrigerant circuit fault rectification work on an air or ground source heat pump system installation

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been developed to reflect some of the performance requirements in the following SummitSkills national occupational standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8]

Support of the unit by a sector or other appropriate body

This unit is endorsed by SummitSkills

Assessment

This unit will be assessed by:

- A practical assignment

Unit 334 Inspect, service and maintain heat pump installations (non-refrigerant circuits) (ET0005HP)

Outcome 1 Undertake the non-refrigerant circuit routine service and maintenance of an air source heat pump system installation

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the work
2. Undertake a **visual service and maintenance inspection** of an air source heat pump installation
3. Undertake **routine servicing of relevant components** an air source heat pump installation
4. Undertake **routine service and maintenance functional tests** on an air source heat pump installation
5. Complete the relevant service and maintenance records in accordance with industry recognised procedures

Range

Visual service and maintenance inspection to include checks in relation to:

- compliance with manufacturer's installation instructions
- compliance with statutory regulations
- condition of system components including cleanliness
- checking the system fluid levels
- checking the system pressure levels
- checks to ensure that electrical controls and temperature sensors are set correctly
- leakage and/or dampness
- correct positioning of system components
- pipework insulation is of the correct grade, in good condition and is firmly in place
- provision of information and safety labels
- security of fixing of system components

Routine servicing of relevant components to include checks in relation to:

- checking for protection of the system water against freezing
- cleaning and lubrication of system components
- adjustment of system controls

Routine service and maintenance functional tests to confirm:

- safe operation
- efficient operation
- the correct functioning of system components/controls
- no undue noise or vibration

Unit 334 Inspect, service and maintain heat pump installations (non-refrigerant circuits) (ET0005HP)

Outcome 2 Undertake the non-refrigerant circuit routine service and maintenance of an ground source heat pump system installation

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the work
2. Undertake a **visual service and maintenance inspection** of an ground source heat pump installation
3. Undertake **routine servicing of relevant components** a ground source heat pump installation
4. Undertake **routine service and maintenance functional tests** on a ground source heat pump installation
5. Complete the relevant service and maintenance records in accordance with industry recognised procedures

Range

Visual service and maintenance inspection to include checks in relation to:

- compliance with manufacturer's installation instructions
- compliance with statutory regulations
- condition of system components including cleanliness
- checking the system fluid levels
- checking the system pressure levels
- checks to ensure that electrical controls and temperature sensors are set correctly
- leakage and/or dampness
- correct positioning of system components
- pipework insulation is of the correct grade, in good condition and is firmly in place
- provision of information and safety labels
- security of fixing of system components

Routine servicing of relevant components to include checks in relation to:

- checking for protection of the system water against freezing
- cleaning and lubrication of system components
- adjustment of system controls

Routine service and maintenance functional tests to confirm:

- safe operation
- efficient operation
- the correct functioning of system components/controls
- no undue noise or vibration

Unit 334

Inspect, service and maintain heat pump installations (non-refrigerant circuits) (ET0005HP)

Outcome 3

Undertake non-refrigerant circuit fault diagnosis work on an air or ground source heat pump system installation

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the fault diagnosis work
2. Identify the cause of **faults**
3. Agree with the relevant person(s) fault rectification procedures for the faults identified

Range

A minimum of FOUR separate **faults** from the following list:

- heat pump low pressure trip/alarm activated by a collector circuit malfunction
- heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- poor or no collector circuit performance
- insufficient heat output to emitter circuit
- domestic hot water heat up is satisfactory but space heating is not operating
- system noise and/or vibration

Unit 334

Inspect, service and maintain heat pump installations (non-refrigerant circuits) (ET0005HP)

Outcome 4

Undertake non-refrigerant circuit fault rectification work on an air or ground source heat pump system installation

Assessment Criteria

The learner can:

1. Obtain the relevant information required to enable the fault rectification work
2. Take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work
3. Take relevant precautionary actions to minimize the risk of injury to self or others during the fault rectification work
4. Rectify **faults**
5. Undertake post-rectification functional tests in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures to confirm that the system is in a safe, functional and efficient condition.

Range

A minimum of TWO separate **faults** from the following list:

- heat pump low pressure trip/alarm activated by a collector circuit malfunction
- heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- poor or no collector circuit performance
- insufficient heat output to emitter circuit
- domestic hot water heat up is satisfactory but space heating is not operating
- system noise and/or vibration

Unit 341

Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Level: 3
Credit value: 4
UAN: T/602/3109

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence.

The unit focuses upon the knowledge required to plan and prepare for, install (including testing and commissioning) and handover of rainwater harvesting and greywater reuse systems. The unit primarily covers systems up to 6m³ of storage volume but will also have relevance to systems with a storage volume in excess of 6m³. The unit also includes fundamental design awareness and component selection outcomes but does not include detailed design.

Learning outcomes

There are **twelve** learning outcomes to this unit. The learner will be able to:

1. Know the Health and Safety risks and safe systems of work associated with rainwater harvesting and greywater reuse system installation work
2. Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work
3. Know the types and layouts of rainwater harvesting and greywater reuse system used for single premises installations
4. Know the purpose of components used within rainwater harvesting and greywater reuse systems
5. Know the information requirements to enable rainwater harvesting and greywater reuse system component selection and sizing
6. Know the fundamental techniques used to select, size and position components for rainwater harvesting and greywater reuse systems
7. Know options and requirements for the treatment of water in biological, physical, biomechanical and hybrid rainwater harvesting/greywater recycling systems
8. Know the preparatory work required for rainwater harvesting and greywater recycling system installation work
9. Know the requirements for installing rainwater harvesting and greywater reuse storage tanks
10. Know the requirements for installing for rainwater harvesting and greywater recycling system pipework
11. Know the requirements to test and commission rainwater harvesting and greywater re-use system installations
12. Know the requirements to handover rainwater harvesting and greywater recycling systems

Guided learning hours

It is recommended that **35** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Identify Systems, Equipment and Components [M8].
- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1].
- Install Environmental Technology Systems, Equipment and Components [EVTS 2].
- Test Environmental Technology Systems, Equipment and Components [EVTS 3].
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4].

The outcomes of this unit are aligned to the relevant rainwater harvesting and greywater re-use minimum technical competence knowledge requirements for the following scheme:

- Building Regulations Competent Person Schemes (England and Wales).

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by:

- an on-line multiple-choice e-assessment test.

Unit 341 **Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)**

Outcome 1 Know the Health and Safety risks and safe systems of work associated with rainwater harvesting and greywater reuse system installation work

Assessment Criteria

The learner can:

1. confirm which aspects of rainwater harvesting and greywater reuse system installation work pose **risks**
2. confirm safe systems of work for rainwater harvesting and greywater reuse system installation work **in relation to prevention.**

Range

Risks:

- Electrocutation/electric shock.
- Infection.
- Toxic poisoning.
- Asphyxiation.
- Personal injury though component/equipment handling.

Work in relation to prevention of:

- electrocution/electric shock
- infection
- toxic poisoning
- asphyxiation
- personal injury though component/equipment handling.

Unit 341 Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 2 Know the requirements of relevant regulations/standards relating to practical installation, testing and commissioning activities for solar thermal hot water system installation work

Assessment Criteria

The learner can:

1. interpret building regulation/building standards guidance documentation as relevant to rainwater harvesting and greywater reuse system installation work to identify the **requirements**
2. interpret industry recognised water regulation/byelaw guidance documentation as relevant to rainwater harvesting and greywater reuse system installation work to identify the **requirements**.

Range

Requirements in relation to (2.1):

- notification of the work
- maintaining the structural integrity of the building
- maintaining the fire resistant integrity of the building
- the prevention of moisture ingress (building water tightness)
- cold water supply requirements
 - water quality
 - water efficiency
- roof drainage system installation
- rainwater and greywater storage tank installation
- compliance certification.

Requirements in relation to (2.2):

- notification of the work
- backflow and contamination prevention requirements
- marking and labelling requirements
- use of the harvested/reused water.

Unit 341

Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 3

Know the types and layouts of rainwater harvesting and greywater reuse system used for single premises installations

Assessment Criteria

The learner can:

1. identify the **rainwater harvesting systems types**
2. identify the **greywater reuse systems types**
3. confirm where in system layouts the following backflow prevention arrangements for wholesome back up water supply are required:
 - type AA air gap
 - type AB air gap.

Range

Rainwater harvesting systems types:

- Gravity supply.
- Direct pumped.
- Pumped to storage cistern, gravity distribution.

Greywater reuse systems types:

- Direct reuse.
- Short retention.
- Basic physical/chemical.
- Biological.
- Bio-mechanical.
- Hybrid.

Unit 341

Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 4

Know the purpose of components used within rainwater harvesting and greywater reuse systems

Assessment Criterion

The learner can:

1. confirm the purpose of rainwater harvesting and greywater reuse system **components**.

Range

Components:

- Anti-surge valve.
- Calmed inlet.
- Inlet filter.
- Level sensor/float switch.
- Module (including pump and air gap).
- Pump control unit.
- System control unit.
- Expansion vessel (direct systems).
- Water level gauge.

Unit 341

Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 5

Know the information requirements to enable rainwater harvesting and greywater reuse system component selection and sizing

Assessment Criteria

The learner can:

1. confirm the information requirements in relation to:
 - building design
 - building dimensions
 - building location and orientation
 - building fabric/material details
 - existing wholesome water supply systems
 - existing rainwater and waste water systems
 - proposed use of the harvested rainwater/greywater
2. confirm the information requirements in relation to:
 - building occupancy
 - demand/usage
 - any special features.

Unit 341 Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 6 Know the fundamental techniques used to select, size and position components for rainwater harvesting and greywater reuse systems

Assessment Criteria

The learner can:

1. confirm how to determine the **storage capacity (litres) of a greywater reuse system** within a single premises using the simplified approach
2. confirm how to determine the **storage capacity (litres) of a rainwater harvesting system** within a single premises using the simplified approach
3. confirm which materials are typically suitable for the manufacture of rainwater harvesting and greywater reuse tanks and cisterns
4. confirm the requirements for durability in relation to the materials selected for rainwater harvesting and greywater reuse system tanks and components
5. confirm the design **requirements** for rainwater harvesting and greywater reuse storage tank/cistern installation
6. confirm the options for providing a back-up water supply within a rainwater harvesting or greywater reuse system
7. confirm the **requirements** of pump installation within a rainwater harvesting or greywater reuse system
8. confirm which materials are suitable for rainwater harvesting and greywater reuse system collection and distribution pipework and fittings
9. state typical collection and distribution system pipe sizes for rainwater harvesting and greywater reuse systems for pipework between the storage tank and the system control unit.

Range

Storage capacity (litres) of a greywater reuse system in relation to:

- occupancy
- greywater yield
- greywater demand/usage.

Storage capacity (litres) of a rainwater harvesting system in relation to:

- roof plan area (tiled pitched roofs)
- average annual rainfall depth for the location
- building occupancy.

Requirements in relation to (6.5):

- prevention of stagnation of the stored water
- provision of covers and vents
- prevention of contamination/microbial growth
- keeping the stored water dark and cold
- provision and sizing of an overflow

- prevention of surcharging via overflow pipework
- termination of overflows from rainwater harvesting storage tanks
- termination of overflows from greywater reuse storage tanks
- proximity to trees
- contaminated ground
- groundwater levels
- ground strength and stability
- proximity to utilities and foundations.

Requirements in relation to (6.7):

- prevention of dry-running
- prevention of sound and vibration transfer
- prevention of overheating
- provision of non-return valves
- provision of isolating valves
- provision of a pump failure alarm
- provision of controls
- provision for monitoring.

Unit 341 **Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)**

Outcome 7 Know options and requirements for the treatment of water in biological, physical, biomechanical and hybrid rainwater harvesting/greywater recycling systems

Assessment Criteria

The learner can:

1. state when the inclusion of a water treatment arrangement in rainwater harvesting and greywater recycling systems:
 - is a regulatory requirement
 - may be beneficial or good practice
2. confirm the working principles of a UV disinfection system
3. confirm the typical **installation arrangements for a UV disinfection system**
4. confirm the options for the chemical treatment of water in rainwater harvesting and greywater recycling systems.

Range

Installation arrangements for a UV disinfection system in relation to:

- water sample points
- filters
- flow restrictors
- isolation valves.

Unit 341

Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 8

Know the preparatory work required for rainwater harvesting and greywater recycling system installation work

Assessment Criteria

The learner can:

1. state the requirements in relation to:
 - authorisation for the work to proceed
 - the availability of appropriate access to all required work areas
2. confirm the **requirements** of pre-installation checks.

Range

Requirement of checks in relation to:

- the suitability of the proposed installation in relation to:
 - yield
 - usage
- the suitability of the building structure and the building fabric in relation to the installation of system components
- the inspection of the existing water supply installation
- the inspection of the existing rainwater and/or greywater installation
- the availability of a suitable electrical input service
- the proposed siting of key internal system components.

Unit 341

Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)

Outcome 9

Know the requirements for installing rainwater harvesting and greywater reuse storage tanks

Assessment Criteria

The learner can:

1. confirm the requirements to maintain the structural integrity of the tank if holes need to be cut within a storage tank during the installation process
2. confirm the requirements for mounting and supporting above ground tanks and cisterns.

Unit 341 **Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)**

Outcome 10 Know the requirements for installing for rainwater harvesting and greywater recycling system pipework

Assessment Criteria

The learner can:

1. confirm the requirement of the connection arrangement where rainwater and greywater overflow and drainage pipework connects to the underground drainage system
2. confirm which jointing methods are acceptable for rainwater and greywater pipework collection pipework
3. confirm which jointing methods are acceptable for rainwater and greywater pipework distribution pipework.

Unit 341 **Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)**

Outcome 11 Know the requirements to test and commission rainwater harvesting and greywater re-use system installations

Assessment Criteria

The learner can:

1. confirm the **requirements** to prepare for testing and commissioning
2. confirm the testing **requirements** for hydraulic testing of the distribution system
3. confirm the test procedure to check that cross-connections have not been introduced
4. confirm the typical commissioning **requirements** for a rainwater harvesting system installation
5. confirm the commissioning **requirements** for a greywater re-use system installation
6. state the recording requirements for the commissioning of rainwater harvesting and greywater re-use system installations.

Range

Requirements in relation to (11.1):

- compliance with the system design and specification
- compliance with system/component manufacturer requirements
- suitability of electrical supply circuit arrangements
- flushing the system of installation debris
- filling the storage tank
- provision of marking and labelling to system pipework and components.

Requirements n relation to (11.2):

- test pressure
- test duration
- permitted leakage
- pass criteria.

Requirements in relation to (11.4):

- setting of the system fluid levels
- setting of mechanical controls
- setting of electrical controls
- system functional tests
- water quality checks.

Requirements in relation to (11.5):

- setting of the system fluid levels
- setting of mechanical controls
- setting of electrical controls
- system functional tests
- water quality checks.

Unit 341 **Know the requirements to install, commission and handover rainwater harvesting and greywater re-use systems (ET002WHR)**

Outcome 12 Know the requirements to handover rainwater harvesting and greywater recycling systems

Assessment Criteria

The learner can:

1. confirm the pre-handover checks that need to be carried out
2. confirm industry **handover procedures**.

Range

Handover procedures in relation to the:

- provision of written information
- provision of diagrammatic information
- provision of verbal information/demonstration relating to system operation and use.

Unit 342

Install, commission and handover rainwater harvesting and greywater re-use systems (ET003WHR)

Level: 3
Credit value: 2
UAN: K/602/3110

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence.

The unit focuses upon the occupational competence required to plan and prepare for, install (including testing and commissioning) and handover of rainwater harvesting and greywater reuse systems. The unit primarily covers systems up to 6 m³ of storage volume but will also have relevance to systems with a storage volume in excess of 6 m³.

Learning outcomes

There are **four** learning outcomes to this unit. The learner will be able to:

1. Plan and prepare for the installation of rainwater harvesting and greywater reuse systems
2. Install rainwater harvesting and greywater reuse system components
3. Test and commission rainwater harvesting and greywater reuse systems
4. Hand over rainwater harvesting and greywater reuse systems

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the performance objectives relevant to the following SummitSkills National Occupational Standards:

- Plan for Environmental Technology Systems, Equipment and Components [EVTS 1]
- Install Environmental Technology Systems, Equipment and Components [EVTS 2]
- Test Environmental Technology Systems, Equipment and Components [EVTS 3]
- Commission Environmental Technology Systems, Equipment and Components [EVTS 4]

The outcomes of this unit are aligned to the relevant rainwater harvesting and greywater reuse minimum technical competence requirements for the following scheme:

- Building Regulations Competent Person Schemes (England and Wales)

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by:

- A practical assignment

Unit 342 Install, commission and handover rainwater harvesting and greywater re-use systems (ET003WHR)

Outcome 1 Plan and prepare for the installation of rainwater harvesting and greywater reuse systems

Assessment Criteria

The learner can:

1. undertake **pre-installation checks** for a rainwater harvesting or greywater reuse system installation
2. confirm that the tools, materials and equipment required for the installation work are available and are in a safe usable condition.

Range

Pre-installation checks:

- the suitability of the proposed installation in relation to:
 - yield
 - usage
 - any special features
- the suitability of the building structure and the building fabric in relation to the installation of system components
- the inspection of the existing water supply installation
- the inspection of the existing rainwater and/or greywater installation
- the availability of a suitable electrical input service
- the proposed siting of key internal system components.

Unit 342 **Install, commission and handover rainwater harvesting and greywater re-use systems (ET003WHR)**

Outcome 2 Install rainwater harvesting and greywater reuse system components

Assessment Criterion

The learner can:

1. install in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures, key system components on either a rainwater harvesting or greywater reuse system to include as a minimum the positioning, fixing and connection of the **components**.

Range

Components:

- Storage tank (connection to tank only).
- System control unit (water connections only).
- Pump.

Unit 342 Install, commission and handover rainwater harvesting and greywater re-use systems (ET003WHR)

Outcome 3 Test and commission rainwater harvesting and greywater reuse systems

Assessment Criteria

The learner can:

1. prepare a rainwater harvesting or greywater reuse system for **testing and commissioning**
2. test a rainwater harvesting or greywater reuse distribution system for hydraulic soundness using appropriate test equipment in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures
3. undertake the relevant test procedure to check that cross-connections have not been introduced
4. identify the commissioning requirements for a rainwater harvesting or greywater reuse **installation**
5. commission a rainwater harvesting and greywater reuse system in accordance with manufacturer's guidance, design requirements, client's requirements and statutory requirements and/or industry recognised procedures
6. complete relevant documentation to record the rainwater harvesting or greywater reuse system commissioning activities.

Range

Testing and commissioning to include checks/actions to:

- confirm compliance with the system design and specification
- confirm compliance with system/component manufacturer requirements
- confirm the suitability of electrical supply circuit arrangements
- flushing the system of installation debris
- filling the storage tank
- confirm the provision of appropriate marking and labelling to system pipework and components.

Installation in relation to:

- the system/component manufacturer(s) requirements
- system design/specification requirements
- the client/end user requirements
- statutory regulations and/or industry recognised procedures.

Unit 342 Install, commission and handover rainwater harvesting and greywater re-use systems (ET003WHR)

Outcome 4 Hand over rainwater harvesting and greywater reuse systems

Assessment Criteria

The learner can:

1. undertake relevant checks on either a rainwater harvesting or greywater reuse system to ensure that the system is ready for handover and compliant with manufacturer's guidance, the system design/specification, client's requirements, regulatory requirements and/or industry recognised requirements
2. explain and demonstrate to the end user the operation and use of either a rainwater harvesting or greywater reuse system using manufacturer's guidance and industry agreed handover procedures
3. identify and explain to the end user any aspects of the rainwater harvesting or greywater reuse system that varies from the agreed specifications and requirements
4. obtain acceptance by the end user of the rainwater harvesting or greywater reuse system according to the industry agreed handover procedures
5. ensure that all relevant handover documentation is correctly completed and recorded in the appropriate information systems and passed to the end user in accordance with manufacturer's guidance and industry recognised procedures.

Unit 343

Know the requirements to inspect, service and maintain rainwater harvesting and greywater re-use systems (ET004WHR)

Level: 3
Credit value: 2
UAN: M/602/3111

Unit aim

The purpose and aim of this unit is to enable learners to develop the underpinning knowledge required prior to progressing to assessment of occupational competence.

The unit focuses upon the knowledge required to inspect, service and maintain rainwater harvesting and greywater reuse systems. The unit primarily covers systems up to 6 m³ of storage volume but will also have relevance to systems with a storage volume in excess of 6 m³.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will be able to:

1. Know the requirements for the routine service and maintenance of rainwater harvesting and reuse systems
2. Know how to diagnose faults in rainwater harvesting and greywater reuse systems
3. Know how to rectify faults in rainwater harvesting and greywater reuse systems

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the knowledge requirements relevant to the following SummitSkills National Occupational Standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8]

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills

Assessment

This unit will be assessed by:

- An on-line multiple-choice e-assessment test

Unit 343

Know the requirements to inspect, service and maintain rainwater harvesting and greywater re-use systems (ET004WHR)

Outcome 1

Know the requirements for the routine service and maintenance of rainwater harvesting and reuse systems

Assessment Criteria

The learner can:

1. confirm which documentation needs to be available to enable routine service and maintenance work on rainwater harvesting and greywater reuse systems
2. confirm the **typical routine service and maintenance requirements** for a rainwater harvesting system
3. confirm the typical routine service and maintenance requirements for greywater reuse systems
4. confirm the **relevant guideline values** for the general monitoring of water quality in rainwater harvesting and greywater reuse systems
5. state what equipment is required to monitor water quality in rainwater harvesting and greywater reuse systems
6. confirm the industry requirements for the recording and reporting of routine service and maintenance work on rainwater harvesting and greywater reuse systems

Range

Typical routine service and maintenance requirements in relation to:

- visual inspection requirements
- cleaning of components
- functional tests

The relevant guideline values in relation to:

- dissolved oxygen (stored rainwater)
- suspended solids
- colour
- turbidity
- pH
- residual chlorine
- residual bromine

Unit 343

Know the requirements to inspect, service and maintain rainwater harvesting and greywater re-use systems (ET004WHR)

Outcome 2

Know how to diagnose faults in rainwater harvesting and greywater reuse systems

Assessment Criteria

The learner can:

1. confirm the information that needs to be available to enable fault diagnosis
2. confirm the work action and sequences required to diagnose the following faults:
 - poor or no flow into storage tank
 - system pump fails to operate
 - back-up water supply fails to operate
 - water quality is unacceptable
 - undue system noise or vibration

Unit 343

Know the requirements to inspect, service and maintain rainwater harvesting and greywater re-use systems (ET004WHR)

Outcome 3

Know how to rectify faults in rainwater harvesting and greywater reuse systems

Assessment Criterion

The learner can:

1. confirm the work action and sequences required to rectify the following faults:
 - poor or no flow into storage tank
 - system pump fails to operate
 - back-up water supply fails to operate
 - water quality is unacceptable
 - undue system noise or vibration

Unit 344

Inspect, service and maintain rainwater harvesting and greywater re-use systems (ET005WHR)

Level: 3
Credit value: 2
UAN: A/602/3130

Unit aim

The purpose and aim of this unit is to enable learners to demonstrate occupational competence.

The unit focuses upon the occupational competence required to inspect, service and maintain (including fault diagnosis and rectification) rainwater harvesting and greywater reuse systems. The unit primarily covers systems up to 6 m³ of storage volume but will also have relevance to systems with a storage volume in excess of 6 m³.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will be able to:

1. Undertake the routine service and maintenance of rainwater harvesting and greywater reuse systems
2. Undertake fault diagnosis work on rainwater harvesting and greywater reuse systems installations
3. Undertake fault rectification work on rainwater harvesting and greywater reuse systems installations

Guided learning hours

It is recommended that **15** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

Learners achieving the outcomes of this unit will have demonstrated that they have met some of the performance objectives relevant to the following SummitSkills National Occupational Standards:

- Inspect Environmental Technology Systems, Equipment and Components [EVTS 5]
- Diagnose Faults in Environmental Technology Systems, Equipment and Components [EVTS 6]
- Rectify Faults in Environmental Technology Systems, Equipment and Components [EVTS 7]
- Service and Maintain Environmental Technology Systems, Equipment and Components [EVTS 8]

Support of the unit by a sector or other appropriate body

This unit is endorsed by the SSC SummitSkills.

Assessment

This unit will be assessed by:

- A practical assignment

Unit 344 Inspect, service and maintain rainwater harvesting and greywater re-use systems (ET005WHR)

Outcome 1 Undertake the routine service and maintenance of rainwater harvesting and greywater reuse systems

Assessment Criteria

The learner can:

1. obtain the relevant information required to enable the work
2. undertake a **visual service and maintenance inspection** of a rainwater harvesting or greywater reuse system installation
3. undertake **routine servicing** of relevant components on a rainwater harvesting or greywater reuse system
4. undertake **routine service and maintenance functional tests** on a rainwater harvesting or greywater reuse system
5. complete the relevant service and maintenance records in accordance with industry recognised procedures.

Range

Visual service and maintenance inspection to include checks in relation to:

- compliance with manufacturer's installation instructions
- compliance with statutory regulations
- condition of system components including cleanliness
- correct positioning of system components
- security of fixing of system components.

Routine servicing to include:

- checking the system water levels
- checking the system water quality
- cleaning of system components
- adjustment of system controls.

Routine service and maintenance functional tests to confirm:

- safe operation
- efficient operation
- the correct functioning of system components/controls.

Unit 344 **Inspect, service and maintain rainwater harvesting and greywater re-use systems (ET005WHR)**

Outcome 2 Undertake fault diagnosis work on rainwater harvesting and greywater reuse systems installations

Assessment Criteria

The learner can:

1. obtain the relevant information required to enable the fault diagnosis work
2. diagnose the cause of a minimum of four separate faults on a rainwater harvesting and/or greywater reuse system from the following list:
 - Poor or no flow into storage tank.
 - System pump fails to operate.
 - Back-up water supply fails to operate.
 - Water quality is unacceptable.
 - Undue system noise or vibration.
3. agree with the relevant person(s) fault rectification procedures for the faults identified.

Unit 344 **Inspect, service and maintain rainwater harvesting and greywater re-use systems (ET005WHR)**

Outcome 3 Undertake fault rectification work on rainwater harvesting and greywater reuse systems installations

Assessment Criteria

The learner can:

1. obtain the relevant information required to enable the fault rectification work
2. take relevant precautionary actions to prevent unauthorised use of the system prior to or during the fault rectification work
3. take relevant precautionary actions to minimize the risk of injury to self or others during the fault rectification work
4. rectify **faults** on a rainwater harvesting and/or greywater reuse system
5. undertake post-rectification functional tests in accordance with manufacturer's guidance, regulatory requirements and industry recognised procedures to confirm that the system is in a safe, functional and efficient condition.

Range

A minimum of TWO separate **faults** from the following list:

- Poor or no flow into storage tank.
- System pump fails to operate.
- Back-up water supply fails to operate.
- Water quality is unacceptable.
- Undue system noise or vibration.

Appendix 1 Relationships to other qualifications

Links to other qualifications and frameworks

This qualification has links to City & Guilds Level 3 Domestic Plumbing and Heating (6189).

Literacy, language, numeracy and ICT skills development

This qualification includes opportunities to develop and practise many of the skills and techniques required for success in the following qualifications:

- Functional Skills (England) – see www.cityandguilds.com/functionalskills
- Essential Skills (Northern Ireland) – see www.cityandguilds.com/essentialskillsni
- Essential Skills Wales (from September 2010).

There might also be opportunities to develop skills and/or portfolio evidence if learners are completing any Key Skills alongside this qualification.

Appendix 2 Centre resource guidelines

The following guidelines have been produced to ensure that centres seeking approval for the environmental technologies qualifications (2399) understand the resource requirements to enable them to offer this qualification. The resources needed relate specifically to the assessment requirements for each unit.

All practical assessments for these qualifications can be taken in simulated test areas. Simulated test areas can be set up so that they are suitable for both installation and maintenance assessments.

2399-312 Install, commission and handover small scale solar photovoltaic systems

(Information taken from v1.1 of the *Assessment Guide*)

Assessment area

The assessment tasks require the provision of suitable assessment areas and physical resources to enable assessment through realistic simulation. The assessment areas **must** replicate a real working environment in keeping with typical on-site commercial conditions. The physical resources **must** comprise up-to-date tools and equipment and up-to-date full-size system components.

Task A – Plan and prepare for the installation of a new solar photovoltaic system

The centre will show the candidate the proposed installation location details on paper; hence there are no equipment resources required for this task.

Task B – Install a photovoltaic array

Candidates shall be given a dimensioned physical layout drawing showing the module arrangement, distance from the edge of the roof, etc.

Candidates shall be provided with all necessary hand tools, PPE and a range of test equipment. All tools and equipment must comply with current guidelines and test equipment shall be regularly checked for accuracy.

A detailed specification for the mock roof for this task is given in Appendix 1 of the *Unit 312 Assessment Guide* available on www.cityandguilds.com.

The following is a typical list of tools and equipment needed to run this task – it is not intended to be an exhaustive list of requirements. Specific requirements will vary depending on the exact design of test rig adopted by the centre.

PPE

- helmets
- hi-visibility jackets
- spare boots
- gloves.

Tools

- Cordless drills
- hex socket set
- spanners
- Slater's ripper
- glazer's suction lifters
- tape measures
- Allen keys
- combination spanner
- torx driver bit
- long hex screwdriver bit extension.

Mounting system parts

- Four roof hooks or standoff and flashing kit, depending on roof type used
- Two rails
- Proprietary nuts for mounting system rails
- Module mid-clamps & end-clamps appropriate to type of module and mounting system
- Copper-eaze or Bostik never-seez for corrosion prevention
- Rubber pads if aluminium components are used with galvanised steel components
- Stainless steel high tension wood screws to fit mounting system to rafters/trusses, (diameter must be no more than 10 % of rafter width)
- Cable ties.

PV components

- Two dummy modules (see Appendix 1 of the *Unit 312 Assessment Guide* available on www.cityandguilds.com)
- Pair of 4 mm² PV cables with MC3 male & female connectors at one end for use as main DC cable from array to inverter (for this task the cable needs only to be connected to the array and to penetrate the roof)
- Vent tile to fit type of tiles/slates in use, for cable entry
- PV DC cable including spare negative and positive DC PV connectors.

PV connector tools

Shrouding tool, crimping tool and cable stripping tool which **must** be of the correct type for specific brand of PV connectors to be used (this will depend on the type used by module and inverter).

For outdoor mock roofs

White monotarp tarpaulins and waterproof jackets & trousers.

Task C – Connect, inspect, test, commission and handover a photovoltaic system

For tools, test gear & PPE requirements, please see Appendix 4 of the *Unit 312 Assessment Guide* available on www.cityandguilds.com. Consumables required for this task:

- AC cables
- PV DC cable
- spare negative and positive DC PV connectors.

2399-314 Inspect, service and maintain small scale solar photovoltaic systems

(Information taken from v 1.1 of the Assessment Guide)

Assessment area

The assessment tasks require the provision of suitable assessment areas and physical resources to enable assessment through realistic simulation. The assessment areas **must** replicate a real working environment in keeping with typical on-site commercial conditions. The physical resources **must** comprise up-to-date tools and equipment and up-to-date full-size system components. The assessment areas and physical resources **must** be maintained in a safe, 'fit for purpose' condition including the filling of any fixing holes and redecoration between assessments. The assessment areas and physical resources **must** not be identical to areas used for training purposes and the assessment areas **must** not be used for training purposes.

Resource Requirements

Consumables required for Tasks A, B and C:

- AC cables
- PV DC cable
- spare negative and positive DC PV connectors
- spare crimps and ferrules (Tasks B & C).

Tools, test gear & PPE required for electrical work (Tasks B and C)

Tools

- PV connector shrouding tool, crimping tool and cable stripping tool, must be of the correct type for the specific brand of PV connectors to be used (this will depend on type used by module and inverter)
- four screwdrivers (small Philips, large Philips, small flat, large flat)
- one electrician's cable stripping knife.

Test equipment

- one multifunction tester or separate testers to perform all 17th edition live and dead tests (NB the 17th edition multifunction testers are generally not suitable to measure DC current and voltage, multimeters or clamp-meters are generally used for Isc & Voc tests)
- one multimeter with current range to at least Isc x n x 1.25 and voltage range to at least Voc x m x 1.15
- GS38 approved meter probe leads (red and black, CATIII 1000 V)
- one pair multimeter (red & black plugs) to PV connector cables
- the centre should have processes in place for regular calibration of all test gear.

Note re: DC test leads

Due to the risks associated with carrying out live DC Isc and Voc tests it is strongly recommended that centres use dedicated test leads. These should have an appropriate DC connector at one end and a straight shrouded 4 mm meter connector at the other end. This arrangement should be compatible with most multimeters for the Isc and Voc tests and most multifunction etc testers for the continuity/insulation resistance tests. Therefore, the test rig design should provide for connection of DC PV connectors between the DC isolator and inverter, either with cable connectors or panel mounted DC connectors.

PPE and safety gear

- approved voltage tester (rated to maximum voltages (230 V AC; $V_{oc} \times m \times 1.15$ for DC))
- proving unit (must illuminate both AC and DC indicators on the approved voltage tester)
- one pair of insulated gloves rated to maximum voltage (230 V AC; $V_{oc} \times m \times 1.15$) within date. Inflate by rolling up to check for leaks; any gloves with leaks or out of date to be destroyed
- one insulated matt rated to maximum voltage (230 V AC; $V_{oc} \times m \times 1.15$ for DC)
- 'Danger Live Wires' sign
- 'Do Not Switch On' sign
- padlocks (keyed differently)
- lock-off hasp (if required)
- one clipboard.

2399-322 Install, commission and handover 'active' solar thermal hot water systems

(Information taken from v 1.0 of the Assessment Guide)

Assessment area

Centres will need to provide two types of assessment area. The requirements are as follows:

Assessment Area 1 – Solar collector installation area

Assessment Area 1 must facilitate the completion of Task B.

The area must simulate a pitched roof of timber rafter construction with a fascia board. The rafters are to be covered with either an underslating felt or breathable under tile membrane, timber tile battens and clad with either single or double lap roofing tiles or roofing slates. The roof area must be large enough to accommodate the full-size solar collector and provide at least 500mm clearance in all directions from the edges of the collector. The underside of the roof area must be accessible and include dummy solar circuit flow and return pipework to enable the candidate to connect the solar collector and weather the collector pipework where it penetrates the roof covering.

The assessment area must simulate a real working environment, ie an environment in which real work activities take place under real working conditions in keeping with real commercial situations. The roof area need not be at height. However, the design of the assessment area must require the candidate to work on the roof and use safe systems of work. The candidate must not be able to complete the entire task from the ground.

Assessment Area 2 – Solar hot water system inspection, testing, commissioning and handover area

Assessment Area 2 must facilitate the completion of Task C and Task D.

The area must simulate a fully installed, fully-filled or drainback 'active' solar thermal hot water system. The system must include full-size components and be installed in accordance with manufacturer's instructions, regulatory requirements and industry good practice. The assessment area must simulate a real working environment, i.e. an environment in which real work activities take place under real working conditions in keeping with real commercial situations. The solar thermal hot water system must be capable of being filled and commissioned. Whilst desirable, it is not essential that the solar collector be subjected to real or artificial solar energy during the commissioning activity. In the event that solar collector is not subjected to real or artificial solar energy during the commissioning activity, the assessor must identify methods of enabling the commissioning checks to be completed. For example, the temporary removal of and artificial heating and/or cooling of temperature sensors may enable the operation of the Differential Temperature Controller and the circulating pump to be checked. Please note: The use of halogen lamps is not considered to be an effective method of creating artificial solar energy.

Centres must hydraulically test the installation in accordance with BS6700 prior to any candidate undertaking assessment.

Assessment Area 2 must but be protected by a Residual Current Device and must include a lockable isolator. Centres must arrange for the electrical to be inspected and tested by a competent person prior to any candidate undertaking assessment. Periodic inspection of the installation must also be undertaken.

The use of mobile rigs for the assessment of Task C and D is not possible.

Other assessment resources

As a minimum, centres will need to provide the following:

- system handover documentation aligned with the requirements of the Microgeneration Certification Scheme (MCS) Microgeneration Installation Standard: MIS 3001. The latest version of MIS 3001 can be downloaded from **www.microgenerationcertification.org**
- appropriate access equipment
- appropriate personal protective equipment
- a solar hot water commissioning pump
- a refractometer
- pH test kit.

All assessment resources must be up-to-date to reflect current industry standards/conditions and must be maintained in a safe, 'fit for purpose' condition.

2399-324 Inspect, service and maintain 'active' solar thermal hot water systems

(Information taken from v 1.0 of the Assessment Guide)

Assessment area requirements

Approved centres must provide suitable assessment areas and resources to enable assessment of all tasks through realistic simulation. The assessment tasks may be undertaken using either installed fixed systems or portable assessment rigs. Regardless of whether installed fixed systems or portable assessment rigs are used, the assessment facilities and /equipment must simulate a realistic and working fully-filled or drainback solar hot water system installation.

The assessment facilities must enable each of the fault types listed below to be introduced to **realistic** fully-filled or drainback solar hot water system installations:

- loss of system pressure without evidence of discharge
- discharge from pressure relief valve on the solar primary circuit
- insulation melting on solar collector circuit pipework
- overheating of solar collector circuit
- lack of circulation within the solar collector circuit
- poor or no system performance
- system noise and/or vibration.

The assessment facilities must enable rectification and post-rectification testing for each of the faults listed above. The faults selected for each candidate must be introduced to the system before the candidate is given access to the assessment area. The faults selected must be varied from candidate to candidate. All fault types must be selected for use on a regular basis.

All assessment facilities, whether fixed or portable must but be protected by a Residual Current Device and must include a lockable isolator.

Centres must arrange for the electrical installations to be inspected and tested by a competent person prior to any candidate undertaking assessment. Periodic inspection of the electrical installations must also be undertaken.

Other assessment resources

As a minimum, centres will need to provide the following:

- system handover documentation for the service and maintenance systems aligned with the requirements of the Microgeneration Certification Scheme (MCS) Microgeneration Installation Standard: MIS 3001. The latest version of MIS 3001 can be downloaded from **www.microgenerationcertification.org**
- appropriate access equipment
- appropriate personal protective equipment
- a solar hot water commissioning pump
- a refractometer
- pH test kit.

All assessment resources must be up-to-date to reflect current industry standards/conditions and must be maintained in a safe, 'fit for purpose' condition.

2399-332 Install, commission and handover heat pumps (non-refrigerant circuits)

(Information taken from v 1.0 of the Assessment Guide)

Assessment Area Requirements

Centres will need to provide a minimum of two types of assessment area as follows:

Assessment Area 1

Assessment Area 1 must facilitate the installation, testing and commissioning of an air source heat pump unit (Task B).

The air source heat pump unit used may be either an internal or external packaged unit. A pre-installed and hydraulically tested emitter circuit must be available for the candidate to connect the heat pump unit to the emitter circuit. Where the heat pump unit manufacturer specifies the inclusion of a buffer tank in the emitter circuit, a buffer tank of an appropriate capacity and specification must be included in the pre-installed circuit.

The area must be of sufficient size and layout to enable the candidate to position the heat pump unit and connect the unit to the pre-installed emitter circuit. The layout must require the candidate to connect a minimum of 500mm of flow and return pipework between the heat pump unit and the pre-installed emitter circuit. The assessment area must simulate a real working environment, i.e. an environment in which real work activities take place under real working conditions in keeping with real commercial situations.

Assessment Area 1 must include a suitable pre-installed electrical supply arrangement positioned to enable the candidate to connect the heat pump unit to electricity supply using an in-line 'plug and play' type connector. The candidate is not required to and must not undertake any electrical installation work. All other heat pump system electrical components, controls and wiring must be pre-installed and in a safe and operational condition. Where necessary, additional in-line plug in connectors may be used to connect other heat pump system electrical components and controls. The entire electrical installation must be protected by a Residual Current Device and each assessment area must include a lockable isolator. Centres must undertake electrical safety checks at appropriate intervals to ensure candidate safety.

Assessment Area 2

Assessment Area 2 must facilitate the preparation of a new ground source heat pump installation for testing commissioning and facilitate the testing and commissioning of the installation (Task C).

The ground source heat pump unit used may be either an internal or external packaged unit. The heat pump unit must be positioned by the centre and connected in accordance with manufacturer's instructions to a suitable pre-installed and hydraulically tested emitter circuit. Where the heat pump unit manufacturer specifies the inclusion of a buffer tank in the emitter circuit, a buffer tank of an appropriate capacity and specification must be included in the pre-installed circuit.

A pre-installed collector circuit must be available to enable the candidate to connect the heat pump unit to the collector circuit and to be able to flush, fill and purge the collector circuit. The collector circuit can be a fully installed horizontal ground collector circuit arrangement or bore hole **or** be a simulated collector circuit. Where a simulated collector circuit is used, the circuit must be able to achieve a brine temperature similar to that achieved with a fully installed circuit.

If centres prefer to provide a separate simulated collector circuit to facilitate the flushing, filling and purging aspects of the assessment, this is acceptable providing that:

- I. any separate simulated collector circuit is realistic in terms of pipework material, pipework size and pipework length to a real collector circuit
- II. the ground source heat pump in assessment area 2 has its own collector circuit that facilitates the full commissioning of the unit.

The assessment area(s) must simulate a real working environment, ie an environment in which real work activities take place under real working conditions in keeping with real commercial situations.

Assessment Area 2 must include a suitable pre-installed electrical supply and pre-installed electrical system controls. The candidate is not required to and **must not** undertake any electrical installation work. The entire electrical installation must be protected by a Residual Current Device and each assessment area must include a lockable isolator. Centres must arrange for the electrical installation to be inspected and tested by a competent person prior to any candidate undertaking assessment. Periodic inspection of the installation must also be undertaken.

The use of mobile rigs for the assessment is not possible.

Other assessment resources

As a minimum, Centres will need to provide the following:

- system handover documentation aligned with the requirements of the Microgeneration Certification Scheme (MCS) Microgeneration Installation Standard: MIS 3005. The latest version of MIS 3005 can be downloaded from **www.microgenerationcertification.org**
- appropriate access equipment
- appropriate personal protective equipment
- a collector circuit filling and purging pump unit
- a refractometer
- pH test kit.

2399-334 Inspect, service and maintain heat pump installations (non-refrigerant circuits)

(Information taken from v 1.0 of the Assessment Guide)

Assessment areas

Centres must provide suitable assessment areas and resources to enable assessment of all service and maintenance and fault diagnosis and rectification tasks through realistic simulation. The assessment tasks may be undertaken using either installed fixed systems or a portable assessment rigs. Regardless of whether installed fixed systems or portable assessment rigs are used, the assessment facilities and /equipment must simulate realistic and working air and ground source heat pump installations.

The design of assessment areas must enable the centre to introduce all of the specified faults listed below:

- heat pump low pressure trip/alarm activated by a collector circuit malfunction
- heat pump high pressure trip/alarm activated by an emitter circuit malfunction
- poor or no collector circuit performance
- insufficient heat output to emitter circuit
- domestic hot water heat up is satisfactory but space heating is not operating
- system noise and/or vibration.

The assessment facilities must enable rectification and post-rectification testing for each of the faults listed above. The faults selected for each candidate must be introduced to the system before the candidate is given access to the assessment area. The faults selected must be varied from candidate to candidate. All fault types must be selected for use on a regular basis.

All assessment facilities, whether fixed or portable must but be protected by a Residual Current Device and must include a lockable isolator. Centres must arrange for the electrical installations to be inspected and tested by a competent person prior to any candidate undertaking assessment. Periodic inspection of the electrical installations must also be undertaken.

Other assessment resources

As a minimum, approved centre will need to provide the following:

- system handover documentation for the service and maintenance systems aligned with the requirements of the Microgeneration Certification Scheme (MCS) Microgeneration Installation Standard: MIS 3001. The latest version of MIS 3005 can be downloaded from **www.microgenerationcertification.org**
- appropriate access equipment
- appropriate personal protective equipment
- a refractometer
- pH test kit.

All assessment resources must be up-to-date to reflect current industry standards/conditions and must be maintained in a safe, 'fit for purpose' condition.

2399-342 Install, commission and handover rainwater harvesting and greywater re-use systems

(Information taken from v 1.0 of the Assessment Guide)

Assessment Area Requirements

Centres will need to provide as a minimum an assessment area (or areas) that facilitate the installation, testing, commissioning and handover of a rainwater harvesting **or** re-use installation.

The system type and layout **must** be either directly pumped from storage, or pumped from storage to an intermediate cistern with gravity distribution. Direct re-use (non-storage) systems and gravity fill, gravity distribution systems are not appropriate for the assessment of this unit.

The area(s) must be of sufficient size and layout to enable the candidate to the position, fix and connect a minimum of **one** of the following system components:

- storage tank (connection to tank only)
- system control unit (water connections only)
- pump.

The layout and assessment area(s) must include a functioning mains back-up water supply arrangement. The layout and assessment area must facilitate a cross-connection test procedure in accordance with BS8515:2009 (Rainwater Harvesting Systems) or BS8225:2010 (Greywater Re-use Systems) to be carried out as part of Task B.

The assessment area(s) must simulate a real working environment, i.e. an environment in which real work activities take place under real working conditions, using full-size and up-to-date components in keeping with real commercial situations.

The assessment area(s) must include a suitable pre-installed electrical supply arrangement positioned to enable the candidate to connect the rainwater harvesting or greywater re-use installation to the electricity supply using an in-line 'plug and play' type connector. The candidate is not required to and **must not** undertake any electrical installation work. All other system electrical components, controls and wiring must be pre-installed and in a safe and operational condition. Where necessary, additional in-line plug in connectors may be used to connect other system electrical components and controls. The entire electrical installation **must** be protected by a Residual Current Device and each assessment area must include a lockable isolator. Approved centres must arrange for the electrical installation to be inspected and tested by a competent person prior to any candidate undertaking assessment. Periodic inspection of the installation must also be undertaken.

The use of mobile rigs for the assessment is not possible.

Other assessment resources

As a minimum, Centres will need to provide the following:

- system handover pack documentation (relates to Task C)
 - all manufacturer instruction documents and warranties relating to any installed equipment.
 - the system commissioning checklist and certificates.
 - details of routine maintenance checks to be undertaken by the user.
 - details of required maintenance intervals when the maintenance must be carried out by a competent engineer
 - an 'as fitted' system schematic plan of both plumbing and electrical systems - detailing all functioning components of the heat pump system up to the point of integration with the existing collection and distribution systems.

The items listed can be provided as a separate document for each item or included within a document addressing any of the other documents listed.

- appropriate access equipment
- appropriate personal protective equipment
- appropriate resources to enable cross-connection testing in accordance with BS8515:2009 or BS8525:2010.

All assessment resources must be up-to-date to reflect current industry standards/conditions and must be maintained in a safe, 'fit for purpose' condition.

2399-344 Inspect, service and maintain rainwater harvesting and greywater re-use systems

(Information taken from v 1.0 of the Assessment Guide)

Assessment areas

Approved centres must provide suitable assessment areas and resources to enable assessment of all service and maintenance and fault diagnosis and rectification tasks through realistic simulation. The assessment tasks may be undertaken using either installed fixed systems or a portable assessment rigs. Regardless of whether installed fixed systems or portable assessment rigs are used, the assessment facilities and /equipment must simulate realistic and working rainwater harvesting or greywater re-use system installations.

The design of assessment areas must enable the centre to introduce all of the specified faults listed below:

- poor or no flow into storage tank
- system pump fails to operate
- back-up water supply fails to operate
- water quality is unacceptable
- undue system noise or vibration.

The assessment facilities must enable rectification and post-rectification testing for each of the faults listed above. The faults selected for each candidate must be introduced to the system before the candidate is given access to the assessment area. The faults selected must be varied from candidate to candidate. All fault types must be selected for use on a regular basis.

All assessment facilities, whether fixed or portable must but be protected by a Residual Current Device and must include a lockable isolator. Approved centres must arrange for the electrical installations to be inspected and tested by a competent person prior to any candidate undertaking assessment. Periodic inspection of the electrical installations must also be undertaken.

Other assessment resources

As a minimum, approved centre will need to provide the following:

- system handover documentation for the system to be serviced and maintained to include:
 - all manufacturer instruction documents and warranties relating to any installed equipment.
 - the system commissioning checklist and certificates.
 - details of routine maintenance checks to be undertaken by the user.
 - details of required maintenance intervals when the maintenance must be carried out by a competent engineer
 - an 'as fitted' system schematic plan of both plumbing and electrical systems - detailing all functioning components of the heat pump system up to the point of integration with the existing collection and distribution systems.

The items listed can be provided as a separate document for each item or included within a document addressing any of the other documents listed.

- appropriate access equipment
- appropriate personal protective equipment
- pH test kit.

All assessment resources must be up-to-date to reflect current industry standards/conditions and must be maintained in a safe, 'fit for purpose' condition.

Appendix 3 Reference Materials

Solar Thermal

Publication	Edition/Version	Author/Publisher	ISBN:
Solar Heating Design and Installation Guide	2007	CIBSE	9781903287842
CE 131 Solar water heating systems – guidance for professionals, conventional indirect models	March 2006	Energy Saving Trust	
Water Regulations Guide: including the Water Byelaws 2000 (Scotland)	2001	WRAS	9780953970803

Heat Pumps

Publication	Edition/Version	Author/Publisher	ISBN:
BS EN 15450: 2007 Heating systems in buildings: Design of heat pump heating systems		BSI	9780580563850
TR/30 – Guide to Good Practice Heat Pumps	2007	HVCA	0903783584
CE 82 Domestic Ground Source Heat Pumps: Design and installation of closed-loop systems	2007	Energy Saving Trust	
Water Regulations Guide: including the Water Byelaws 2000 (Scotland)	2001	WRAS	9780953970803

Water Harvesting and Re-use

Publication	Edition/Version	Author/Publisher	ISBN:
BS8515: 2009 Rainwater harvesting systems – Code of Practice		BSI	9780580604904
BS8525 – 1:2010 Greywater systems – Part 1: Code of Practice		BSI	9780580634758
Rainwater Harvesting Design & Installation Guide	2010	CIBSE	9781906846084
Water Regulations Guide: including the Water Byelaws 2000 (Scotland)	2001	WRAS	9780953970803

Guidance on permitted reference materials

Candidates are permitted to take the stated reference materials into the online examinations. Candidates **must not** be permitted to communicate with each other or refer to any other materials.

Permitted reference materials taken into examinations **can** contain the following:

- Bookmarks (e.g. blank post-it notes, post-it notes numbered to indicate chapters or corners of pages folded)
- Highlighting of text

Permitted reference materials taken into exams **must not** contain the following:

- Sample exam questions, answers or diagrams
- Any writing in the regulations or accompanying written notes
- Notes, diagrams or any content that may in any way advantage the candidate in answering questions within the exam.

It is the responsibility of the centre to ensure any material used in the exam does not advantage candidates in anyway.

FAQs

1) Question: **Do we have to access a copy of all these documents for each candidate?**

Answer: No, these documents are not required to answer the questions. However, for some questions, access to these documents may be helpful for clarifying or referencing specific regulatory policy or codes of practice that candidates should have been taught in reference to the unit content. Centres may wish to make a single set of the documents concerned available for the candidates to refer to, rather than a set of documents per candidate.

2) Question: **Can the relevant extracts from the documents be pulled out as reference for candidates so they don't have to browse through lots of irrelevant pages?**

Answer: This is acceptable as long as the originator/owner of the document deems this acceptable or has given permission. Please note that as stated in the guidance above, bookmarks or blank post-it notes to indicate chapters or folded corners of pages can be used.

Sources of general information

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

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

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

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

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

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

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

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

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

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www.cityandguilds.com

Useful contacts

UK learners

General qualification information

T: +44 (0)844 543 0033

E: learnersupport@cityandguilds.com

International learners

General qualification information

T: +44 (0)844 543 0033

F: +44 (0)20 7294 2413

E: intcg@cityandguilds.com

Centres

Exam entries, Registrations/enrolment, Certificates, Invoices, Missing or late exam materials, Nominal roll reports, Results

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: centresupport@cityandguilds.com

Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

F: +44 (0)20 7294 2404 (BB forms)

E: singlesubjects@cityandguilds.com

International awards

Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: intops@cityandguilds.com

Walled Garden

Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: walledgarden@cityandguilds.com

Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

T: +44 (0)121 503 8993

E: business@cityandguilds.com

Publications

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If you have a complaint, or any suggestions for improvement about any of the services that City & Guilds provides, email: feedbackandcomplaints@cityandguilds.com

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