

22272VIC Course in Pyrometric Requirements for Thermal Processing



This course has been accredited under Parts 4.4 and 4.6 of the Education and Training Reform Act, 2006. It has been entered on the *State Register of Accredited Courses and Recognised Qualifications* and the National Training Register
www.training.gov.au

The period of accreditation is from : 1st July 2014 to 30th June 2019

Document Status

This document is an exact copy of the document, which is listed on the State Register of Accredited Courses and Recognised Qualifications and the National Training Register.
Version 1: Accredited from 1st July 2014 to June 30th 2019



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VU21620	Conduct pyrometric measurements	18
VU21621	Perform thermal processing to required standard	22
VU21622	Manage the thermal process	27
VU21623	Conduct thermal processing on different materials	34
VU21624	Conduct internal audits	40

Section A: Copyright and course classification information

<p>1. Copyright owner of the course</p>	<p>Copyright of this document is held by the Department of Education and Early Childhood Development, Victoria. © State of Victoria</p>
<p>2. Address</p>	<p>Department of Education and Early Childhood Development Higher Education and Skills Group Executive Director, Pathways Participation and Facilitation Division, GPO Box 4367 Melbourne VIC 3001</p> <p><u>Day to day contact:</u> Engineering Industries (Electrical Electronics) Curriculum Maintenance Manager CMM id: 5128 Box Hill Institute of TAFE Email: g.adda@bhtafe.edu.au (T): 03 9286 9880 (F): 03 9286 9991</p>
<p>3. Type of submission</p>	<p>Accreditation.</p>
<p>4. Copyright acknowledgement</p>	<p>Copyright of this material is reserved to the Crown in the right of the State of Victoria. © State of Victoria (Department of Education and Early Childhood Development) 2014</p>
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6. Course accrediting body	Victorian Registration and Qualifications Authority	
7. AVETMISS information	ANZSCO (OCCUPATIONAL TYPE) CODES	233911 Aerospace Engineers
	ASCED (Field of education) Code	0315 Aerospace Engineering and Technology
	National course code	22272VIC
8. Period of accreditation	1 July 2014 to 30 June 2019	

Section B: Course information

1. Nomenclature <i>Standard 1 AQTF Standards for Accredited Courses</i>	
1.1 Name of the qualification	Course in Pyrometric Requirements for Thermal Processing
1.2 Nominal duration of the course	50-90 hours
2. Vocational or educational outcomes <i>Standard 1 AQTF Standards for Accredited Courses</i>	
2.1 Purpose of the course	The Course in Pyrometric Requirements for Thermal Processing aims to provide training that will facilitate compliance with International thermal processing standards relevant to aerospace industries.
3. Development of the course <i>Standards 1 and 2 AQTF Standards for Accredited Courses</i>	
3.1 Industry / enterprise/ community needs	<p>The Institute of Instrumentation Control and Automation (IICA) have identified the need for post-trade nationally recognised training in compliance with relevant aerospace standards. These standards include:</p> <ul style="list-style-type: none"> • AMS 2750 • European • USA • Australian • Boeing <p>The standards cover pyrometric requirements for thermal processing equipment used for heat treatment. They cover:</p> <ul style="list-style-type: none"> • Thermal processing equipment • System accuracy tests • Temperature uniformity surveys • Temperature sensors • Instrumentation • Calibration • Reporting <p>The standards are set to ensure that parts or raw materials are heat treated in accordance with the applicable specifications.</p> <p>Virtually all those involved with aircraft maintenance that provide their labour and/or services as external contractors/sub-contractors fall under the mandatory requirements of having to comply with relevant standards. This includes persons engaged in the manufacture of new components, in the repair of components, engines, airframes, working with metal alloys, composites, calibrations, checking of furnaces etc.</p>

	<p>The industry sectors that cover the functions listed above are also very diverse. These include: engineering sectors such as electrical, mechanical, instrumentation and can also include institutions, suppliers, service providers and contractors.</p> <p>Generally people working in aerospace maintenance are already qualified at professional or trade level. Their qualifications and skills span a range of different areas. All require an understanding and knowledge of the standards and compliance is mandatory.</p> <p>Australia's lack of compliance with the requirements of relevant standards continues to prevent non-compliant companies, i.e. the majority, from tendering for jobs overseas in areas of aerospace manufacturing, servicing and so on, that pertain to compliance issues.</p> <p>The USA, UK, Germany and Asian countries, to name a few, have had compliance courses ever since the standards were introduced in 2008. The few Australian companies who have realised the economic potential of becoming compliant have had to register to undertake overseas courses, with the additional expense of having to bring examiners and auditors to Australia.</p> <p>The Course in Pyrometric Requirements for Thermal Processing is designed to correct the situation and make Australia more internationally competitive.</p> <p>A Project Steering Committee was established to oversee the development of the Course in Pyrometric Requirements for Thermal Processing. They were:</p> <table data-bbox="608 1249 1469 1621"> <tr> <td>John Shanahan (Chair)</td> <td>Pyrosales Pty Ltd</td> </tr> <tr> <td>Steve Strutt</td> <td>Furnace Engineering Pty Ltd</td> </tr> <tr> <td>Julie Grogan</td> <td>Manufacturing Skills Australia (MSA)</td> </tr> <tr> <td>Rafael Schwarz</td> <td>Thales</td> </tr> <tr> <td>Amita Lyer</td> <td>RMIT University</td> </tr> <tr> <td>Suzanne Wells</td> <td>Department of Education</td> </tr> <tr> <td>Michael Broom</td> <td>Civil Aerospace Safety Authority (CASA)</td> </tr> <tr> <td>Tony Viney</td> <td>Aerospace Australia (AAA)</td> </tr> <tr> <td>Michael Zeng</td> <td>Qantas Calibration Services</td> </tr> <tr> <td>Chris Lonergan</td> <td>Instrumentation Process Automation Calibration (IPAC)</td> </tr> </table> <p><u>In attendance:</u></p> <table data-bbox="608 1653 1334 1722"> <tr> <td>George Adda</td> <td>CMM-Engineering Industries</td> </tr> <tr> <td>Sam McCurdy</td> <td>Dewhurst Consultancy Pty Ltd</td> </tr> </table>	John Shanahan (Chair)	Pyrosales Pty Ltd	Steve Strutt	Furnace Engineering Pty Ltd	Julie Grogan	Manufacturing Skills Australia (MSA)	Rafael Schwarz	Thales	Amita Lyer	RMIT University	Suzanne Wells	Department of Education	Michael Broom	Civil Aerospace Safety Authority (CASA)	Tony Viney	Aerospace Australia (AAA)	Michael Zeng	Qantas Calibration Services	Chris Lonergan	Instrumentation Process Automation Calibration (IPAC)	George Adda	CMM-Engineering Industries	Sam McCurdy	Dewhurst Consultancy Pty Ltd
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<p>3.2 Review for re-accreditation</p>	<p>Not applicable</p>																								

4 Course outcomes	Standards 1, 2, 3 and 4 AQTF Standards for Accredited Courses
4.1 Qualification level	This course does not align with any specific level of the Australian Qualifications Framework (AQF)
4.2 Employability skills	Not applicable
4.3 Recognition given to the course	Not applicable
4.4 Licensing/ regulatory requirements	Not applicable
5 Course rules	Standards 2, 6, 7 and 9 AQTF Standards for Accredited Courses
5.1 Course structure To be eligible for the award of a Statement of Attainment for the 'Course in Pyrometric Requirements for Thermal Processing', participants must successfully complete a total of 3 units comprising: <ul style="list-style-type: none"> • 2 core units • 1 elective unit <p>Learners who do not complete all the required units for the award will be issued with a Statement of Attainment listing any completed units.</p>	

Table 1: Course in Pyrometric Requirements for Thermal Processing

Unit of competency code	Field of Education code	Unit of competency title	Pre-requisite	Nominal hours
Core unit				
VU21619	031599	Apply relevant pyrometric calibration standards for thermal processing	None	10
VU21620	031599	Conduct pyrometric measurements	VU21619	20
Electives (Select one)				
VU21621	031599	Perform thermal processing to required standard	VU21620	60
VU21622	031599	Manage the thermal process	VU21620	20
VU21623	031599	Conduct thermal processing on different materials	VU21620	60
VU21624	031599	Conduct internal audits	VU21620	20
Total hours				50-90

<p>5.2 Entry requirements</p>	<p>Entrants to the Course in Pyrometric Requirements for Thermal Processing will generally be qualified tradespersons or engineers with experience in the aerospace industries who want to undertake, or who have responsibilities for compliance with relevant national and international standards for thermal processing.</p> <p>There are no barriers to entry on the grounds of age, gender, political or cultural background.</p>
<p>6. Assessment Standards 10 and 12 AQTF Standards for Accredited Courses</p>	
<p>6.1 Assessment strategy</p>	<p>Course assessment (Including Recognition of Prior Learning) must be consistent with the requirements of the Standard 1 (Element 1.5) of the AQTF: <i>Essential Conditions and Standards for Continuing Registration</i> and Standard SNR15.5 of the <i>Standards for NVR Registered Training Organisations</i>.</p> <p>Assessment methods should be flexible, valid, reliable and fair. Assessment of units requires evidence of satisfactory performance for each element and its associated performance criteria and the required skills and knowledge through a variety of tasks</p> <p>A variety of assessment methods and evidence gathering techniques may be used with the overriding consideration being that the combined assessment must stress demonstrable performance by the student. Assessment tools must take into account the requirements of the unit in terms of skills, knowledge and performance.</p> <p>Assessment methods must include the demonstration of practical skills and may also include:</p> <ul style="list-style-type: none"> • oral or written questioning • presentations • case study analyses • written reports • research projects <p>Evidence requirements for the assessment of competence are specified in each unit. Where appropriate, training providers are encouraged to take a holistic approach, by assessing more than one element concurrently, or combining the final assessment for more than one unit.</p> <p>If Training Package units are imported through a maintenance process then assessment of these unit/s of competency must be carried out in accordance with the relevant Training Package guidelines.</p> <p>All participants may seek Recognition for Prior Learning (RPL) for any competencies that they have already gained through previous study or experience.</p>

<p>6.2 Assessor competencies</p>	<p>The National Skills Standards Council (NSSC) or its successor is responsible for determining the training and assessment competencies to be held by assessors in accordance with Standard 1.4 of the AQTF: <i>Essential Conditions and Standards for Initial and Continuing Registration</i> and Standards SNR 4.4 and 15.4 of the <i>Standards for NVR Registered Training Organisations</i>.</p> <p>Accordingly, the NSSC has determined that from 1 July 2013, assessors must:</p> <ul style="list-style-type: none"> i. hold the <i>TAESS00001 Assessor Skill Set</i>, or be able to demonstrate equivalence of competencies; and ii. be able to demonstrate vocational competencies at least to the level being assessed; and iii. be able to demonstrate how they are continuing to develop their VET knowledge and skills as well as maintaining their industry currency and assessor competence. <p>Note:</p> <p>If a person does not have all the assessment competencies as defined in (i) ,(ii) and (iii) then one or more persons with the combined expertise in (i), (ii) and (iii) may work together to conduct the assessment.</p>
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7. Delivery	Standards 11 and 12 AQTF Standards for Accredited Courses
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<p>7.1 Delivery modes</p>	<p>All units of competency in the course may be delivered in a variety of modes: classroom delivery, workplace projects, practical work, self-paced learning, case studies, role plays and guest speakers.</p> <p>It is recommended that the course be conducted using workplace project-based delivery and assessment methods to maximise opportunities for learners to have learning experiences, which are as close as possible to a real workplace environment.</p> <p>Delivery options, including grouping of learners and learning activities, should recognise the varying learning needs, educational backgrounds, preferred learning styles and constraints of the individual learner and the specific requirements of each unit.</p> <p>Some areas of content may be common to more than one unit and therefore integration may be appropriate. Delivery strategies should actively involve the learner and learning should be experiential, relevant and age appropriate.</p> <p>This course is available for full or part-time study. Providers should be flexible in the way the training is delivered to ensure they meet the needs of the client group.</p> <p>The units of competency may be contextualised to meet the needs of different groups of students. Generally this means:</p>
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	<ul style="list-style-type: none"> • Elements and associated performance criteria must not be altered in any way; • The Range Statement may be expanded as long as it does not increase the complexity of the unit • The Evidence Guide may be expanded as long as it retains the integrity of the unit and does not jeopardise the student's potential to achieve the competency.
<p>7.2 Resources</p>	<p>The minimum resources required to conduct the course include access to:</p> <ul style="list-style-type: none"> • furnaces/ovens • relevant instrumentation for thermal processing • copies of relevant standards • relevant case study materials • relevant videos on thermal processing • computer and relevant software • workplace resources, such as current legislation, regulations and codes pertaining to aerospace engineering <p>Qualifications of Trainers</p> <p>The National Skills Standard Council (NSSC), or its successor, is responsible for determining the competencies to be held by trainers in accordance with Standard 1.4a of the AQTF: <i>Essential Conditions and Standards for Continuing Registration</i> and Standards SNR 4.4 and 15.4 of the <i>Standards for NVR Registered Training Organisations</i>.</p> <p>Accordingly, the NSSC has determined that from 1 July 2013, trainers must:</p> <ol style="list-style-type: none"> hold the <i>TAE40110 Certificate IV in Training and Assessment</i> from the TAE10 Training and Education Training Package as a minimum qualification, or be able to demonstrate equivalence of competencies; and be able to demonstrate vocational competencies at least to the level being delivered and assessed; and be able to demonstrate how they are continuing to develop their VET knowledge and skills as well as maintaining their industry currency and trainer/ assessor competence. <p>Persons delivering training under the supervision of a trainer must:</p> <ol style="list-style-type: none"> work under the supervision of a trainer with the <i>TAE40110 Certificate IV in Training and Assessment</i>, or of a person who has demonstrated equivalence of competencies; and hold either the <i>TAESS00007 Enterprise Trainer – Presenting Skill Set</i>, or be able to demonstrate equivalence of competencies, or the <i>TAESS00008 Enterprise Trainer – Mentoring Skill Set</i>, or be able to demonstrate equivalence of competencies within two years of commencing to deliver training while under supervision; and be able to demonstrate vocational competencies at least to the level being delivered and assessed as well as maintaining

	their industry currency.
8. Pathways and articulation	<p><i>Standard 8 for accredited courses</i></p> <p>There is no formal articulation or credit transfer arrangements into other VET or higher education qualifications.</p>
9. Ongoing monitoring and evaluation	<p><i>Standard 13 for accredited courses</i></p> <p>Ongoing evaluation and validation of the Course in Pyrometric Requirements for Thermal Processing is the responsibility of the Curriculum Maintenance Manager, Engineering Industries.</p> <p>The course will be monitored and maintained by an Industry Advisory Committee with representatives from:</p> <ul style="list-style-type: none"> • Aerospace industry • CASA • industry associations or peak bodies • RTOs delivering the course. <p>The following methods will be used to provide data to the Industry Advisory Committee:</p> <ul style="list-style-type: none"> • student surveys • employer surveys • trainer/assessor feedback <p>The CMM - Engineering Industries will meet with the Industry Advisory Committee at least once in the middle of the accreditation period and more frequently if necessary, to:</p> <ul style="list-style-type: none"> • review the implementation of the program; • provide advice on changing program requirements; • monitor and evaluate course standards, delivery and assessment; • determine whether the course should be replaced by an endorsed Training Package qualification, or unit(s) of competency. <p>Recommendations for any significant changes will be reported through the Curriculum Maintenance Manager, Engineering Industries to the Victorian Registration and Qualification Authority (VRQA).</p> <p>Course maintenance and review procedures will also indicate that the course should be expired if a suitable qualification or unit(s) of competency becomes available through the endorsement of a Training Package.</p>

Section C – Units of Competency

Unit Code	Unit Title	Page
VU21619	Apply relevant pyrometric calibration standards for thermal processing	14
VU21620	Conduct pyrometric measurements	18
VU21621	Perform thermal processing to required standard	22
VU21622	Manage the thermal process	27
VU21623	Conduct thermal processing on different materials	34
VU21624	Conduct internal audits	40

VU21619 Apply relevant pyrometric calibration standards for thermal processing

Unit Descriptor

This unit provides the skills and knowledge to enable participants to apply strategies that facilitate compliance with relevant standards for thermal processing required for particular aerospace jobs.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Application of the Unit

The unit would be applied by those involved in aerospace manufacturing or servicing, where parts or raw materials need to be heat treated in accordance with the applicable specifications.

It would be applicable to work conducted by a wide range of trade and engineering sectors in aerospace industries.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- | | |
|---|---|
| 1 Interpret relevant standard requirements | 1.1 A copy of the relevant standard is sourced for analysis
1.2 Industry terms relevant to the job are employed appropriately
1.3 Standard compliance requirements relevant to the job are identified
1.4 Implications of non-compliance with relevant aspects of the Standard are clarified
1.5 Relevant OHS/WHS requirements are identified and addressed |
| 2 Apply quality control procedures to maintain compliance | 2.1 The quality control plan is reviewed in consultation with relevant personnel
2.2 Quality control checks are carried out to maintain compliance with the standard
2.3 Records are maintained to ensure ongoing compliance |
| 3 Determine areas of non-compliance | 3.1 Areas of non-compliance with the relevant standard are identified and reported to appropriate personnel
3.2 Corrective action is taken to rectify areas of non-compliance
3.3 Strategies are applied to ensure ongoing compliance with relevant aspects of the standard
3.4 All personnel are advised of the need for compliance with the relevant standard and their associated responsibility |

3.5 Procedures to monitor and maintain compliance with the relevant standard are followed.

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- communicating verbally and in writing using correct industry terminology
- sourcing relevant standards
- interpreting specifications and relevant standard requirements for the job
- providing feasible solutions to non-compliance issues relating to the relevant standard
- making recommendations based on analysis and evidence
- conducting system accuracy tests (SAT)
- calculating SAT results
- conducting temperature uniformity surveys (TUS), including:
 - using the results
 - reporting TUS outcomes
- interpreting thermocouple and instrument calibration reports and implementing corrections
- conducting maintaining accurate records for compliance with the relevant standard
- working effectively with others

Required knowledge:

- range of standards relevant to aerospace industries
- specific standard requirements
- industry terminology
- importance of compliance with relevant standard
- OHS/WHS requirements relating to standard compliance
- relevant legislation and regulations for aerospace work
- implications of non-compliance with relevant standard
- temperature sensors
- relevant instrumentation such as:
 - standard instruments
 - test instruments
 - controlling/ monitoring/recording instruments applicable to heat treating
- classification of furnaces and ovens
- uncertainty of measurements
- system accuracy tests (SAT), including:
 - SAT frequency
 - SAT waivers
 - SAT records/reports
- temperature uniformity tests
- pyrometric controls
- application of pyrometric controls
- temperature uniformity survey (TUS), including:
 - when are they needed?
 - TUS failures
 - use of offsets
 - furnace and oven types
 - TUS reports
- recording requirements

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Relevant standards include:

- AMS 2750
- European
- USA
- Boeing
- Australian

Industry terms include:

- Nadcap
- escapes/emissions
- root cause
- preventative action
- carburising
- stress relieving
- load preparation
- quenching
- cycle review

OHS/WHS requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- trainer
- mentor
- teacher
- team member
- quality assurance manager

Quality control plan includes:

- Legislative and regulatory requirements
- Risk analysis
- Control specifications
- Instrumentation
- Testing frequencies
- Responsibilities
- Review mechanisms
- Contingency plans

- Quality control checks** include:
- Appropriate tests, including
 - System accuracy tests (SAT)
 - Temperature uniformity tests (TUS)
 - Testing frequency
 - Calibrations
 - Responsibilities
 - Corrective actions

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Accredited Course.

- Critical aspects for assessment and evidence required to demonstrate competency in this unit**
- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge.
 - In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - maintain compliance with relevant standards and be aware of the implications of non-compliance
 - take corrective action for any areas of non-compliance with the relevant standard
- Context of and specific resources for assessment**
- This unit may be assessed on the job, off the job or a combination of both on and off the job.
 - Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
 - The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
- Method of assessment**
- Assessment must include the demonstration of practical skills and may also include:
 - oral and/or written questioning on required knowledge and skills;
 - case study analysis
 - role-plays.
 - Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21620

Conduct pyrometric measurements

Unit Descriptor

This unit provides the skills and knowledge to enable participants to conduct high temperature measurements using a range of pyrometers.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Pre-Requisite Unit

VU21619 - Apply relevant pyrometric calibration standards for thermal processing

Application of the Unit

The unit would be applied by those involved in manufacturing or servicing areas of the aerospace industries, where parts or raw materials need to be heat treated in accordance with the applicable specifications.

It would be applicable to work conducted by a wide range of trade and engineering sectors involved in thermal processes.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Determine the temperature requirements for thermal processing

- 1.1 A copy of the job specification is sourced for analysis
- 1.2 Temperature compliance requirements relevant to the job are identified
- 1.3 **Industry terms** relevant to the job are employed correctly
- 1.4 Relevant **OHS/WHS requirements** are identified and addressed

2 Employ appropriate temperature sensors

- 2.1 Suitable temperature sensors for the working environment are identified
- 2.2 Sensor choice is verified with **appropriate personnel** against the relevant standard and job specification
- 2.3 Sensors are used effectively to measure temperature at various stages in the thermal process

3 Determine instrumentation requirements

- 3.1 **Instrumentation** needs for the proposed thermal process are confirmed
- 3.2 The role of each instrument in the thermal process is clearly identified
- 3.3 Instruments are set up to meet the needs of the thermal process and in accordance with relevant standard

- 4 Select a suitable furnace/oven for the thermal processing
- 4.1 Available **furnaces and ovens** are compared against the thermal processing requirements of the job to determine the most suitable
- 4.2 Instrumentation needs appropriate to the selected furnace or oven and the job are confirmed.
- 4.3 **Tests** are organised to ensure compliance with relevant standard and job specifications

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- sourcing relevant standard
- interpreting relevant specifications and requirements for the job
- providing feasible solutions to non-compliance issues
- making recommendations based on analysis and evidence
- communicating verbally and in writing effectively
- conducting system accuracy tests (SAT)
- calculating SAT results
- conducting temperature uniformity surveys (TUS), including:
 - using the results
 - reporting TUS outcomes
- working effectively with others

Required knowledge:

- industry terminology
- range of aerospace standards, such as AMS 2750, European, USA, Australian, Boeing etc.
- importance of compliance with relevant standard
- OHS/WHs requirements relating to standard compliance
- relevant legislation and regulations for aerospace work
- implications of non-compliance with relevant standard
- classification of furnaces
- uncertainty of measurements
- system accuracy tests (SAT) compliance
- pyrometric controls
 - sensor tolerances
 - instrumentation tolerances
 - application of pyrometric controls
- temperature uniformity survey (TUS) compliance

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

- Industry terms** include:
- Nadcap
 - escapes/emissions
 - root cause
 - preventative action

OHS/WHS requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Temperature sensors are:

- pyrometers, which include:
 - thermocouples
 - infrared thermometer
 - resistance temperature detector (RTD)
 - optical pyrometer

Appropriate personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- team member
- quality assurance manager

Instrumentation may include:

- standard instruments used in thermal processing
- test instruments
- controlling instruments
- monitoring instruments
- recording instruments

Furnaces and ovens may be classified in terms of:

- Class
- Instrumentation

Tests include:

- System accuracy tests (SAT)
- Temperature uniformity surveys (TUS)

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Accredited Course.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures
 - select and utilise appropriate temperature sensors in compliance with the working environment, job specifications and relevant standard
 - select an appropriate furnace/oven for the thermal process

- set up appropriate instrumentation and quality controls to maintain compliance with relevant standard
- arrange for SAT and TUS tests to maintain compliance

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - oral and/or written questioning on required knowledge and skills
 - case study analysis
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency

VU21621

Perform thermal processing to required standard

Unit Descriptor

This unit provides the skills and knowledge to enable participants to perform thermal processing on aerospace materials and components to specification and in compliance with the relevant standard. It entails a basic knowledge of metallurgical aspects of thermal processing including heat treatment, coating and brazing of metallic materials and bonding, or curing of composite materials

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Pre-Requisite Unit

VU21620 - Conduct pyrometric measurements

Application of the Unit

The unit would be applied by process operators involved in manufacturing or servicing in the aerospace industries, where parts or raw materials need to be heat treated, in accordance with the applicable specifications

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Interpret relevant specifications

- 1.1 A copy of the job specification is sourced for analysis
- 1.2 Compliance requirements of the relevant standard and the job are identified
- 1.3 **Industry terms** relevant to the job are employed correctly
- 1.4 Relevant **OHS/WHS requirements** are identified and addressed
- 1.5 The required **transformation** in the chosen material during thermal processing is confirmed
- 1.6 Relevant thermal processing required to achieve the desired job outcome is determined

2 Set up the thermal process

- 2.1 Relevant **materials** or components are assembled for treatment
- 2.2 Appropriate thermal processing furnace/oven is selected and prepared
- 2.3 **Control instrumentation** is calibrated in compliance with the relevant standard and the job specifications
- 2.4 **Relevant personnel** are advised of the need for compliance and their associated responsibility in relation to the thermal process
- 2.5 Informed decisions are made on whether to load the furnace/oven hot or cold to achieve desired outcomes
- 2.6 Procedures are established to monitor and maintain compliance during the thermal process

- 3 Perform required thermal processing
- 3.1 Furnace/oven is loaded hot or cold, according to the materials being treated and the desired outcome
 - 3.2 **Heat-up rates** are set according to specifications and in compliance with the relevant standard
 - 3.3 Furnace/oven temperatures have correction factors applied and are monitored to ensure thermal process is maintained within specification
 - 3.4 Cooling/quench rate is controlled within specification and in accordance with the relevant standard
 - 3.5 Temperature of the materials is monitored throughout thermal process, as required by the standard
 - 3.6 SAT and TUS tests are conducted to maintain compliance
- 4 Complete the thermal process
- 4.1 Furnace/oven is unloaded in accordance with OHS/WHS requirements and organisation procedures
 - 4.2 Thermal processed materials are quenched, if required, using the appropriate type of quenching
 - 4.3 **Coatings** are applied to the thermal processed materials, if required, and in accordance with job specifications
 - 4.4 A **furnace/oven chart analysis** is conducted to ensure compliance with the job specifications
 - 4.5 Furnace/oven is cleaned and prepared for further thermal processing
 - 4.6 Thermal processed materials are tested to ensure compliance with specifications and stored appropriately
 - 4.7 Relevant records are completed and filed, in accordance with organisation procedures

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- sourcing relevant standard(s)
- interpreting relevant specifications and standards for the job
- making recommendations based on analysis and evidence
- communicating verbally and in writing effectively
- conducting system accuracy tests (SAT)
- calculating SAT results
- completing temperature correction factors from SAT and instrument, or thermocouple data
- conducting temperature uniformity surveys (TUS), including:
 - using the results
 - reporting TUS outcomes
- performing thermal processing according to job specifications
- conducting and maintaining accurate records for compliance with the relevant standards
- working effectively with others

Required knowledge:

- industry terminology
- relevant standard(s) requirements
- importance of compliance with relevant standard(s)
- OHS/WHS requirements relating to relevant standard(s) compliance
- relevant legislation and regulations for aerospace work
- definition of metals
- basic metallurgy
- transformation during heating, cooling and/or quenching
- cryogenic or refrigeration treatments
- implications of non-compliance with relevant standard(s)
- ferrous alloys used in aerospace
- corrosion resistant steels
- non-ferrous alloys used in aerospace
- composite materials
- coatings
 - diffusion coatings
 - nitriding
 - carburising
 - nitriding
 - carbo-nitriding and nitro-carburising
 - ion nitriding
- heat treatments
 - types of annealing utilisation
 - normalising
 - solution heat treatment
 - age/precipitation hardening
 - bonding or curing of carbon fibre composites
- furnace, oven and induction heating
- load preparation and furnace loading
- loading hot versus loading cold
- cleaning and cleanliness
- temperature sensors
- relevant thermal processing instrumentation
- heat up rates
- types of quenching
- classification of furnaces/ovens
- uncertainty of measurements
- system accuracy tests (SAT) compliance
- temperature uniformity surveys (TUS)
- temperature controls
- unloading
- cycle review
- quality provisions
- storage
- furnace/oven chart analysis
- quality provisions
- recording requirements

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Industry terms include:

- Nadcap
- escapes/emissions
- root cause
- preventative action
- carburising
- stress relieving
- load preparation
- quenching
- advanced materials
- cycle review

OHS/WHS requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

Materials may include:

- ferrous alloys
- non-ferrous alloys
- corrosion resistant steels
- coatings
- advanced materials, such as carbon fibre and advanced composites

Control instrumentation may include:

- standard instruments used in thermal processing
- test instruments
- controlling instruments
- monitoring instruments
- recording instruments

Relevant personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- team member

Heat up rates involve:

- start and end of soak
- cooling rates
- time at temperature
- furnace/oven cooling
- air cooling

Coatings may include:

- diffusion coatings
- carburising

- nitriding
- media for diffusion coatings
- factors that influence diffusion coatings

Furnace/oven chart analysis
includes:

- verification of compliance
- time at temperature
- start and end of soak

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Accredited Course.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - provide thermal processing of materials in compliance with job specifications and in compliance with relevant standard
 - use appropriate instrumentation and quality controls to maintain compliance with relevant standard
 - arrange for SAT and TUS tests to maintain compliance
 - take corrective action for any areas of non-compliance with relevant standard

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - oral and/or written questioning on required knowledge and skills;
 - case study analysis.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21622

Manage the thermal process

Unit Descriptor

This unit provides the skills and knowledge to enable participants to review and approve thermal processes and procedures, resolve and avoid common problems in thermal processing and to determine operator suitability.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Pre-Requisite Unit

VU21620 - Conduct pyrometric measurements

Application of the Unit

The unit would be applied by those responsible for evaluating existing thermal processes and procedures, designing new thermal processes and resolving issues associated with normal operation.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

1 Interpret relevant specifications

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

- 1.1 A copy of the job specification is sourced for analysis
- 1.2 Compliance requirements of the relevant standard and the job are identified
- 1.3 ***Industry terms*** relevant to the job are employed correctly
- 1.4 Relevant ***OHS/WHS requirements*** are identified and addressed
- 1.5 A ***plan is*** developed to perform the thermal process to specification using appropriate ***resources***
- 1.6 Relevant thermal process required to achieve the desired job outcome is determined.
- 1.7 The job specification is used to produce standard operating procedures and the information is passed on using the work hierarchy and flow down arrangements

2 Organise appropriate training

- 2.1 Skills required to undertake the thermal process to specification are determined.
- 2.2 Operator capabilities are assessed against the skills needs for the job
- 2.3 Training is arranged to address any skills gap that is identified
- 2.4 Competence of workers assigned to the thermal process is confirmed and recorded

- 3 Prepare for the thermal process
 - 3.1 Relevant **materials** or components are assembled for treatment and placed in the furnace/oven within the qualified work space
 - 3.2 Appropriate thermal processing furnace/oven is selected and prepared
 - 3.3 **Control instrumentation** is calibrated in compliance with the relevant standard and the job specifications and correction factors applied
 - 3.4 **Relevant personnel** are advised of the need for compliance and their associated responsibility in relation to the thermal process
 - 3.5 Relevant **operator approvals** are sought prior to commencing thermal processing
 - 3.6 **Equipment capability** to perform high quality thermal processing is confirmed
 - 3.7 Informed decisions are made on whether to load the furnace hot or cold to achieve desired outcomes
 - 3.8 Arrangements are made to monitor and maintain compliance during the thermal process

- 4 Perform required thermal processing
 - 4.1 Different **forms of thermal processing** required by the operational plan are arranged
 - 4.2 Preparatory thermal processing of the materials is performed, if required
 - 4.3 Furnace/oven is loaded hot or cold, according to the materials being treated and the desired outcome
 - 4.4 **Heat-up rates** are set according to specifications and in compliance with the relevant standard
 - 4.5 Furnace/oven temperatures are monitored to ensure thermal processing is maintained within specification
 - 4.6 Cooling rate is controlled within specification and in accordance with the relevant standard
 - 4.7 Quenching is employed, if required, in accordance with job needs and specifications
 - 4.8 Temperature of the materials is monitored throughout the thermal process, as required by the standard
 - 4.9 SAT and TUS tests are conducted to maintain compliance

- 5 Complete the thermal process
 - 5.1 Furnace/oven is unloaded in accordance with OHS/WHS requirements and organisation procedures
 - 5.2 Heat treated materials are quenched, if required, using the appropriate **type of quenching**
 - 5.3 **Coatings** are applied to the heat treated materials, if required, and in accordance with job specifications
 - 5.4 A **furnace/oven chart analysis** is conducted to ensure compliance with the job specifications

- 5.5 Furnace/oven is cleaned and prepared for further thermal processing
- 5.6 Heat treated materials are tested to ensure compliance with specifications and stored appropriately
- 5.7 Thermal processes and procedures are evaluated to achieve best practice and adjust if necessary in accordance with standard guidelines
- 5.8 Relevant records are completed and filed, in accordance with organisation and standard procedures

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- sourcing relevant standard(s)
- interpreting relevant specifications and standards for the job
- making recommendations based on analysis and evidence
- conducting training needs analysis
- organising training to address skills gaps
- communicating verbally and in writing effectively
- conducting system accuracy tests (SAT)
- calculating SAT results
- conducting temperature uniformity surveys (TUS), including:
 - using the results
 - reporting TUS outcomes
- maintaining accurate records
- working effectively with others

Required knowledge:

- industry terminology
- relevant standard(s) requirements
- importance of compliance with relevant standard(s)
- OHS/WHS requirements relating to relevant standard(s) compliance
- relevant legislation and regulations for aerospace terminology work
- definition of metals
- basic metallurgy
- transformation during heating, cooling and/or quenching
- cryogenic or refrigeration treatments
- implications of non-compliance with relevant standard(s)
- ferrous alloys used in aerospace
- corrosion resistant steels
- non-ferrous alloys used in aerospace
- composite materials
- coatings
 - diffusion coatings
 - nitriding
 - carburising
 - nitriding
 - carbo-nitriding and nitro-carburising

- ion nitriding
- heat treatments
 - types of annealing utilisation
 - normalising
 - solution heat treatment
 - age/precipitation hardening
- furnace, oven and induction heating
- load preparation and furnace loading
- loading hot versus loading cold
- cleaning and cleanliness
- temperature sensors
- relevant thermal processing instrumentation
- heat up rates
- types of quenching
- classification of furnaces
- uncertainty of measurements
- system accuracy tests (SAT) compliance
- temperature uniformity surveys (TUS)
- temperature controls
- unloading
- cycle review
- quality provisions
- storage
- furnace chart analysis
- quality provisions
- recording requirements

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Industry terms include:

- Nadcap
- escapes/emissions
- root cause
- preventative action
- carburising
- stress relieving
- load preparation
- quenching
- advanced materials
- cycle review

OHS/WHS requirements may include:

- legislation
- protective equipment
- material safety management systems
- hazardous substances and dangerous goods code
- local safe operation procedures
- awards provisions

- A plan** may include:
- interpretation of specifications
 - contract review
 - specifications
 - materials involved
 - equipment
 - resources
 - parameters
 - testing arrangement
- Resources** may include:
- furnace/oven
 - instrumentation
 - materials for thermal processing
 - temperature sensors
 - staffing
 - quenching arrangement
 - coatings
- Materials** may include:
- composites
 - ferrous alloys used in aerospace industries
 - non-ferrous alloys used in aerospace industries
 - stainless steel
 - advanced materials, such as carbon fibre and advanced composites
- Control instrumentation** may include:
- standard instruments used in thermal processing
 - test instruments
 - controlling instruments
 - monitoring instruments
 - recording instruments
- Relevant personnel** may include:
- supervisor
 - leading hand
 - foreman
 - manager
 - site engineer
 - team member
- Operator approvals** may include:
- general requirements
 - training
 - testing knowledge
 - periodic reviews
 - records
 - training matrices
 - errors and corrective actions
- Equipment capability** may include:
- daily verification
 - SAT, TUS compliance
 - Instruments calibration
 - Thermocouple condition
 - burnout and leak-up tests
 - preventative maintenance

Forms of thermal processing may include:

- types of annealing (Homogenising, normalising, re-crystallisation) utilisation
- solution heat treatment-applications
- age/precipitation hardening-applications
- sub-zero thermal processing– cryogenic versus refrigeration

Heat up rates involve:

- start and end of soak
- cooling rates
- time at temperature
- furnace cooling
- air cooling

Type of quenching may include:

- quenching in oil bath-applications
- quenching in water or polymer-applications
- gas fan quenching versus inert gas
- quenching time
- quench delay
- delay to next operation
- snap temper
- recordings

Coatings may include:

- diffusion coatings
- carburising
- nitriding
- media for diffusion coatings
- factors that influence diffusion coatings

Furnace/oven chart analysis includes:

- verification of compliance
- time at temperature
- start and end of soak

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Accredited Course.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - conduct training needs analyses and organise training to meet skills gaps
 - develop plans to conduct thermal processing to meet client needs and in compliance with the relevant standard
 - provide thermal processing to materials in compliance with job specifications and in compliance with relevant standard

- use appropriate instrumentation and quality controls to maintain compliance with relevant standard
- arrange for SAT and TUS tests to maintain compliance
- take corrective action for any areas of non-compliance with relevant standard
- evaluate processes and procedures to ensure compliance with client needs and the relevant standards

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - oral and/or written questioning on required knowledge and skills;
 - case study analysis.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21623

Conduct thermal processing on different materials

Unit Descriptor

This unit provides the skills and knowledge to enable participants to conduct thermal processing on different materials used in the aerospace industries in order to achieve required transformations

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills

Pre-Requisite Unit

VU21620 - Conduct pyrometric measurements

Application of the Unit

The unit would be applied by those responsible for conducting thermal processing of different materials in order to achieve required transformations, consistent with job specifications and the relevant standard.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Determine the characteristics of material for thermal processing

- 1.1 **Materials** for thermal processing and the required **transformation** is identified
- 1.2 **Classification** and properties of the material is confirmed
- 1.3 **A plan** for the required thermal process is established consistent with the characteristics of the material

2 Prepare material for thermal processing

- 2.1 Relevant materials are assembled for treatment
- 2.2 Appropriate thermal processing furnace/oven is selected and prepared
- 2.3 **Control instrumentation and thermocouples** are calibrated in compliance with the relevant standard and the job specifications
- 2.4 **Relevant personnel** are advised of the need for compliance and their associated responsibility in relation to the thermal process
- 2.5 **Equipment suitability** to perform high quality thermal processing with large enough qualified work zone is confirmed
- 2.6 Informed decisions are made on whether to load the furnace hot or cold to achieve desired outcomes
- 2.7 Arrangements are made to monitor and maintain compliance during the thermal process

- 3 Perform required thermal processing
- 3.1 Different **forms of thermal processing** required by the operational plan are arranged
 - 3.2 Preparatory thermal processing of the materials is performed, if required
 - 3.3 Furnace/oven is loaded hot or cold, according to the materials being treated and the desired outcome
 - 3.4 **Heat-up rates** are set according to specifications and in compliance with the relevant standard
 - 3.5 Furnace/oven temperatures are monitored to ensure they are maintained within specification
 - 3.6 Cooling rate is controlled within specification and in accordance with the relevant standard
 - 3.7 Quenching is employed, if required, in accordance with job needs and specifications
 - 3.8 Temperature of the materials is monitored throughout the thermal processing in accordance with standard
 - 3.9 SAT and TUS tests are conducted to maintain compliance
- 4 Complete the thermal process
- 4.1 Furnace/oven is unloaded in accordance with OHS/WHs requirements and organisation procedures
 - 4.2 Thermal processed materials are quenched, if required, using the appropriate **type of quenching**
 - 4.3 **Coatings** are applied to the heat treated materials, if required, and in accordance with job specifications
 - 4.4 A **furnace/oven chart analysis** is conducted to ensure compliance with the job specifications
 - 4.5 Furnace/oven is cleaned and prepared for further thermal processing
 - 4.6 Thermal processed materials are tested to ensure compliance with specifications and stored appropriately
 - 4.7 Evaluate thermal processes and procedures to achieve best practice and adjust if necessary
 - 4.8 Relevant records are completed and filed, in accordance with organisation and standards procedures

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- sourcing relevant standard(s)
- interpreting relevant specifications and standards for the job
- making recommendations based on analysis and evidence

- communicating verbally and in writing effectively
- conducting system accuracy tests (SAT)
- calculating SAT results
- conducting temperature uniformity surveys (TUS), including:
 - using the results
 - reporting TUS outcomes
- maintaining accurate records
- working effectively with others

Required knowledge:

- industry terminology
- characteristics of materials for thermal processing
- relevant standard(s) requirements
- importance of compliance with relevant standard(s)
- OHS/WHS requirements relating to relevant standard(s) compliance
- relevant legislation and regulations for aerospace work
- definition of metals
- basic metallurgy
- transformation during heating, cooling and/or quenching
- cryogenic or refrigeration treatments
- implications of non-compliance with relevant standard(s)
- ferrous alloys used in aerospace
- corrosion resistant steels
- non-ferrous alloys used in aerospace
- composites
- coatings
 - diffusion coatings
 - nitriding
 - carburising
 - nitriding
 - carbo-nitriding and nitro-carburising
 - ion nitriding
- heat treatments
 - types of annealing utilisation
 - normalising
 - solution heat treatment
 - age/precipitation hardening
- furnace and induction heating
- load preparation and furnace loading
- loading hot versus loading cold
- cleaning and cleanliness
- temperature sensors
- relevant thermal processing instrumentation
- heat up rates
- types of quenching
- classification of furnaces
- uncertainty of measurements
- system accuracy tests (SAT) compliance
- temperature uniformity surveys (TUS)
- application of pyrometric controls
- unloading

- cycle review
- quality provisions
- storage
- furnace chart analysis
- quality provisions
- recording requirements

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Materials may include:

- ferrous alloys used in aerospace
- corrosion resistant steels
- non-ferrous alloys used in aerospace
- advanced materials, such as carbon fibre and advanced composites

Transformation may include:

- age strengthening
- re-crystallisation
- stress relief

Classification includes:

- metals
- alloys
- non-metals
- polymers
- composites

A plan may include:

- interpretation of specifications
- contract review
- specifications
- materials involved
- equipment
- resources
- thermal processing parameters
- testing arrangement

Control instrumentation may include:

- standard instruments used in thermal processing
- test instruments
- controlling instruments
- monitoring instruments
- recording instruments

Relevant personnel may include:

- supervisor
- leading hand
- foreman
- manager
- site engineer
- team member

Equipment suitability may include:

- daily verification
 - SAT, TUS compliance
 - Instruments calibration
 - Thermocouple condition
- burnout and leak-up tests
- preventative maintenance

Forms of thermal processing may include:

- types of annealing utilisation
- normalising
- solution heat treatment-applications
- age/precipitation hardening-applications
- sub-zero – cryogenic versus refrigeration

Heat up rates involve:

- start and end of soak
- cooling rates
- time at temperature
- furnace cooling
- air cooling

Type of quenching may include:

- quenching in oil bath-applications
- quenching in water or polymer-applications
- gas fan quenching versus inert gas
- quenching time
- quench delay
- delay to next operation
- snap temper
- recordings

Coatings may include:

- diffusion coatings
- carburising
- nitriding
- media for diffusion coatings
- factors that influence diffusion coatings

Furnace/oven chart analysis includes:

- verification of compliance
- time at temperature
- start and end of soak

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Accredited Course.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;

- develop plans to conduct thermal processing to meet client needs and in compliance with the relevant standard
- provide thermal processing for different materials in compliance with job specifications and relevant standards
- use appropriate instrumentation and quality controls to maintain compliance with relevant standard
- arrange for SAT and TUS tests to maintain compliance
- take corrective action for any areas of non-compliance with relevant standard
- evaluate processes and procedures to ensure compliance with client needs and the relevant standards

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - oral and/or written questioning on required knowledge and skills;
 - case study analysis.
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.

VU21624

Conduct internal audits

Unit Descriptor

This unit provides the skills and knowledge to enable participants to organise, conduct and report on National Aerospace and Defence Contractors Accreditation Program (Nadcap) audits.

No licensing, legislative, regulatory or certification requirements apply to this unit at the time of publication.

Employability Skills

This unit contains Employability Skills.

Pre-Requisite Unit

VU21620 - Conduct pyrometric measurements

Application of the Unit

The unit would be applied by those suppliers, managers and employees in aerospace industries who are responsible for maintaining an internal audit program.

ELEMENT

Elements describe the essential outcomes of a unit of competency.

PERFORMANCE CRITERIA

Performance criteria describe the required performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge and/or the range statement. Assessment of performance is to be consistent with the evidence guide.

1 Communicate the need for regular internal audits

1.1 Employees at all levels are advised of the need for regular internal audits and their role in the audits

1.2 The origin of particular requirements for auditing is explained in terms of compliance with the relevant aerospace standards

1.3 The ***implications of non-compliance*** being identified at audit are explained to all staff

2 Prepare to conduct an audit

2.1 The three main areas of focus for internal audits are identified

2.2 A qualified and experienced auditor is assigned to conduct the audit

2.3 An ***audit plan*** is developed and appropriate resources assigned to facilitate the audit

2.4 Relevant standards are identified for the work to determine any non-compliance

2.5 Appropriate checklists are developed for each area of focus that are based on ***Nadcap*** requirements

2.6 Management are advised of the audit date and requirements in advance.

2.7 A ranking system is adopted to facilitate the analysis and evaluate the effectiveness of the program

- | | | |
|---|-----------------------------------|--|
| 3 | Conduct the internal audit | 3.1 Management is advised of the data required and the need for staff cooperation. |
| | | 3.2 The audit is undertaken with integrity using established audit protocols and good communication techniques |
| | | 3.3 The importance of personal audits in a program and the need for relevant documentation are emphasised |
| | | 3.4 Suitable objective evidence is gathered and recorded during the audit on which to make decisions of compliance or non-compliance |
| | | 3.5 Collected data is analysed to provide an interim decision of compliance |
| | | 3.6 The audit is completed by providing a verbal summary of the findings to the responsible person |
| 4 | Provide an audit report | 4.1 A detailed analysis of the data collected is conducted to identify any areas of non-compliance |
| | | 4.2 A written report on the audit methodology and its findings is prepared, in accordance with the organisation's procedures |
| | | 4.3 The audit report is submitted to the responsible person for consideration and corrective action, if necessary |
| 5 | Organise a follow-up to the audit | 5.1 A plan of corrective action to address areas of non-compliance is developed, which identifies responsibilities and timelines |
| | | 5.2 Regular checks are made to ensure that areas of non-compliance are corrected promptly |
| | | 5.3 Management are advised when non-compliances have been rectified, or if no action is being taken |

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit

Required skills:

- sourcing relevant standard(s)
- interpreting relevant specifications and standards for the job
- making recommendations based on analysis and evidence
- communicating verbally and in writing effectively
- questioning techniques
- maintaining accurate records
- working effectively with others

Required knowledge:

- industry terminology
- audit terminology
- audit protocols
- relevant standard(s) requirements
- importance of compliance with relevant standard(s)

- OHS/WHS requirements relating to relevant standard(s) compliance
- relevant legislation and regulations for aerospace work
- implications of non-compliance with relevant standard(s)
- quality provisions
- recording requirements

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording in the Performance Criteria is detailed below. Add any essential operating conditions that may be present with training and assessment depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts.

Implications of non-compliance may include:

- catastrophic failure of materials in operation
- loss of internal and external tenders
- loss of reputation and business

Audit plan may include:

- interpretation of specifications
- relevant standard requirements
- timelines
- methodology
- contract review
- specifications
- resources required

Nadcap stands for:

- National Aerospace and Defence Contractors Accreditation Program

Communication techniques includes:

- appropriate questioning techniques
- good listening skills
- good interpersonal skills
- recording and reporting skills

Responsible person may include:

- supervisor
- manager
- site engineer

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for this Accredited Course.

Critical aspects for assessment and evidence required to demonstrate competency in this unit

- Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the associated performance criteria using the required skills and knowledge.
- In particular this shall incorporate evidence that shows a candidate is able to:
 - implement Occupational Health and Safety workplace procedures and practices including the use of risk control measures;
 - develop plans to conduct internal audits in compliance with the relevant standard

- assign appropriate resource to facilitate internal audits
- liaise with management on the timing and needs of the audit
- prepare an audit report
- take corrective action for any areas of non-compliance with relevant standard
- arrange follow-up processes to eliminate areas of non-compliance

Context of and specific resources for assessment

- This unit may be assessed on the job, off the job or a combination of both on and off the job.
- Where assessment occurs off the job, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.
- The candidate will have access to all tools, equipment, materials and documentation required and will be permitted to refer to any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.

Method of assessment

- Assessment must include the demonstration of practical skills and may also include:
 - oral and/or written questioning on required knowledge and skills;
 - case study analysis
 - role-plays
- Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency.