No. 728 **17 August 2007**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY (SAQA)

In accordance with Regulation 24(c) of the National Standards Bodies Regulations of 28 March 1998, the Standards Generating Body (SGB) for

Manufacturing and Assembly Processes

registered by Organising Field 06 – Manufacturing, Engineering and Technology, publishes the following Qualification and Unit Standards for public comment.

This notice contains the titles, fields, sub-fields, NQF levels, credits, and purpose of the Qualification and Unit Standards. The full Qualification and Unit Standards can be accessed via the SAQA web-site at **www.saqa.org.za**. Copies may also be obtained from the Directorate of Standards Setting and Development at the SAQA offices, SAQA House, 1067 Arcadia Street, Hatfield, Pretoria.

Comment on the Qualification and Unit Standards should reach SAQA at the address below and ***no later than 17 September 2007.*** All correspondence should be marked **Standards Setting – Manufacturing and Assembly Processes** and addressed to

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SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
National Certificate: Fluid Power

SAQA QUAL ID	*QUALIFICATION TITLE*		
58881	National Certificate: Fluid Power		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
QUALIFICATION TYPE	*FIELD*	*SUBFIELD*	
National Certificate	6 - Manufacturing, Engineering and Technology	Manufacturing and Assembly	
ABET BAND	*MINIMUM CREDITS*	*NQF LEVEL*	*QUAL CLASS*
Undefined	120	Level 2	Regular-Unit Stds Based

PURPOSE OF THE QUALIFICATION
Purpose:

The purpose of this qualification is to provide learners with the standards and range of learning required to work effectively in the fluid power environment, making use of the relevant knowledge to identify different components of fluid power systems and to make up basic electrical and fluid power circuits.

This qualification is the starting point for a person wanting to follow a career in fluid power. The primary skill that is recognised in this qualification is the ability to apply the relevant skills and knowledge to make up basic electrical and mechanical fluid power circuits from engineering drawings and to use and care for the relevant equipment in a responsible manner.

This qualification incorporates an understanding of basic operational procedures and how to read and interpret workshop manuals, workshop procedures, task instructions and job cards, as well as knowledge of engineering tools and equipment.

On completion of this qualification, the learner will be given recognition for the following exit level outcomes:

- Communicate with peers and supervisors in a manufacturing work context.
- Explain the principles of hydraulic and pneumatic power.
- Make up basic fluid power circuits from given drawings and available parts.
- Use and maintain engineering tools.
- Work as part of a team to make up circuits.

These capabilities require an understanding of electrical theory and fluid power principles, concepts of measurement, engineering drawings and circuit diagrams. Hand skills and the use of tools play an important role in this qualification.

Qualifying learners will be able to relate what they are doing to scientific and technological principles and concepts. They will also be able to maintain and support the various policies and procedures related to the safety, health, environment and quality systems that govern their workplace.

What learners achieve in this qualification will serve as a basis for further learning where they will engage more directly in the installation, maintenance and commissioning of fluid power systems.

Learners will generally carry out their role within the context of:

- A fully equipped fluid power workshop.
- Given maintenance and works procedures.
- Given inspection and testing procedures.
- Given Quality Assurance policies, procedures and processes.

Rationale:

Industry is characterised by technologically sophisticated automation processes using systems that integrate the fields of mechanical and electrical engineering with fluid power. The field of fluid power deals with the assembly, installation, commissioning and maintenance of such systems that conform to all safety aspects as per regulations and legislation. People working in the fluid power field require specialised technical skills and knowledge as well as highly developed hand skills to enable them to achieve these requirements.

This is the first qualification in a series for learners who would like to follow a career in fluid power. This series reflects the skills, knowledge and understanding required to perform effectively in industry, whether in micro, small, medium or large enterprises. This qualification focuses on developing skills and knowledge necessary to begin such a career and provides specific learning in the theoretical knowledge of fluid power principles and how these can be applied to electrical and fluid power circuits.

There is a need for this qualification in the industry because many people enter into jobs where they are required to apply fluid power principles in a given context. They will also benefit from learning the fundamental aspects of working as a team and communicating information when making up basic fluid power circuits, as this forms an integral part of the job.

This qualification typically forms the starting point in a career in fluid power and people who achieve this qualification may be employed in the following key positions:

- Engineering assistant.
- Component assembler.
- Storeman.
- Sales trainee.

Learners may advance from these positions to achieve the qualification in fluid power at NQF level 3 where they will be required to install and maintain fluid power systems.

There are currently approximately 3000 people employed in the industry that are required to perform basic fluid power operations as would be learnt through this qualification. This implies that many learners will be able to be given Recognition of Prior Learning (RPL) for one or more unit standards making up this qualification, and that the qualification is required by industry.

RECOGNIZE PREVIOUS LEARNING?

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LEARNING ASSUMED IN PLACE

It is assumed that learners entering a programme towards this qualification have the ability to communicate at NQF Level 1 and have mathematical literacy skills at NQF Level 1. The learning is practical in nature and it is further assumed that learners will have access to a fluid power workshop, whether through the training provider or an employer.

Recognition of Previous Learning:

This qualification may be obtained through the process of RPL. The learner should be thoroughly briefed prior to the assessment and support provided to assist in the process of developing a portfolio. While this is primarily a work-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit level outcomes.

Access to the Qualification:

This qualification recognises the skills, knowledge and values relevant in the workplace and will cater for learners who:

- Have attended courses and need to apply the knowledge gained to activities in the workplace.
- Are already workers and have acquired skills and knowledge without having attended formal training.
- Are part of a learnership program which integrates structured learning and operational experience.

Candidates applying for this qualification need to demonstrate physical competence in operating equipment and should therefore be physically able to contend with the circumstances required in the workshop environment. Access for learners with physical disabilities is dependant on the following:

- Type and severity of disability.
- The nature of the process and requirements of equipment operation.

QUALIFICATION RULES

This qualification consists of a minimum of 120 credits made up as follows:

- Candidates are required to achieve all 20 credits for communication from the available fundamental unit standards.
- Candidates are required to achieve all 16 credits for mathematical literacy within the context of electro-mechanical winding operations.
- Candidates must achieve all 72 credits from the core unit standards.
- Candidates may select additional unit standards from any of the elective unit standards to achieve a minimum of 12 credits.

Note: The elective credits should be chosen in accordance with the requirements of the selected context and the interests of the learner.

EXIT LEVEL OUTCOMES

The exit level outcomes for this qualification reflect a combination of specific outcomes and critical cross-field education and training outcomes. The way in which the critical cross-field outcomes have been advanced through the learning required for this qualification is embedded in the way in which the unit standards have been constructed. Critical cross-field outcomes form the basis of acquiring the skills, knowledge and values acquired through achievement of this qualification. The application of these cross-field outcomes in a specific context results in the achievement of specific outcomes. The integration of specific outcomes from a variety of unit standards results in the ability to achieve the exit level outcomes.

1. Communicate with peers and supervisors in a manufacturing work context.

2. Explain the principles of hydraulic and pneumatic power.

3. Make up basic fluid power circuits from given drawings and available parts.

4. Use and maintain engineering tools and equipment.

5. Work as part of a team to make up circuits.

ASSOCIATED ASSESSMENT CRITERIA
Associated assessment criteria for Exit Level Outcome 1:

1.1 Oral communication is maintained and adapted as required to promote effective interaction in a work context.
1.2 Terminology used is appropriate to the situation and in accordance with normal workplace usage.
1.3 Information related to work tasks is accessed and interpreted from a range of written and oral sources to ensure that work requirements are understood.
1.4 Communication is clear and unambiguous and at an appropriate level for designated target audiences.
1.5 Information communicated is accurate and conveyed in accordance with acceptable timeframes.
1.6 Communication is effective, regular and ongoing.

Associated assessment criteria for Exit Level Outcome 2:

2.1 Fluids and fluid flow is explained in terms of scientific principles.
2.2 Pressure in flow of fluids is described in relation to speed and volume.
2.3 Methods of converting hydraulic and pneumatic power to mechanical power are described in accordance with accepted physics principles.

Associated assessment criteria for Exit Level Outcome 3:

3.1 Fluid power circuit diagrams and symbols are interpreted in terms of the components required and the functions to be performed.
3.2 The different types of fluid power components are identified and described in terms of their application in the circuit.
3.3 Adjustments that can be made are identified and described in terms of the effect on the total system.
3.4 Actuators and valves are described in terms of their functions and potential applications in a system.
3.5 Differences between fluid power connectors are identified and explained in terms of connection and sealing methods.

Associated assessment criteria for Exit Level Outcome 4:

4.1 Engineering tools and equipment are selected and used in accordance with their design and are appropriate for the task at hand.
4.2 Tools and equipment required for the scope of work are sourced from available supplies.
4.3 Tools and equipment are checked for condition prior to use. Faulty tools are identified and replaced or repaired as appropriate.
4.4 Tools and equipment are used according to manufacturer operating guidelines.

Associated assessment criteria for Exit Level Outcome 5:

5.1 Work is conducted safely with due care for self, fellow workers, machines, equipment, materials and environment.
5.2 Work outputs facilitate effective achievement of group goals.
5.3 Personal relations are developed to maximise team output.

5.4 Responsibilities of different team members and the impact of poor workmanship in any area are explained in terms of the team output.

Integrated Assessment:

The integrated assessment must be based on a summative assessment guide. The guide must indicate how the assessor will assess different aspects of the performance and will include:

- Observing the learner at work (in primary activities as well as in other interactions) or by relevant simulations.
- Asking questions and initiating short discussions to test understanding.
- Evaluating records and reports.

While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit level outcomes.

The assessment process should cover both the explicit tasks required for the qualification as well as the understanding of the concepts and principles that underpin the activities required of fluid power. The assessment process should also establish how the critical outcomes have been advanced by the learning process.

INTERNATIONAL COMPARABILITY

Fluid Power companies in South Africa are mostly representative of, or affiliated to, international counterparts. Work standards are benchmarked against international best practices, and these practices were used as the basis for compiling unit standards. Major global industry players have contributed to the process of establishing appropriate standards and international comparability. This qualification was compared to similar outcomes-based qualifications in various countries as follows:

Australia:

Australia was chosen because its fluid power industry is service-based, similar to South Africa with mining, construction, fishing, agriculture, pulp and paper, automotive and off-shore industry activities that make use of fluid power systems.

The Australian National Training Authority have developed standards in fluid power that are incorporated into qualifications such as "printing and graphic arts", "automotive industry manufacturing" and "pulp and paper manufacturing", whereas the proposed qualification is directed towards a trade in fluid power. The proposed National Certificates are similar to the Australian Standards in that they:

- Set forth standards for competency based instruction and assessment directly related to the workplace.
- Outline assessment standards along with assessor qualifications.
- Require a balanced approach to the qualifications which include application and conceptual understanding of basic principles.
- Include the availability/process for RPL.
- Include unit standards.

The proposed National Certificates differ from the Australian standards in that they:

- Are specific to fluid power as an individual qualification. The Australian system uses individual Units of Competence regarding pneumatics and hydraulics which form part of engineering certificates.
- The South African unit standards are more detailed and specific, with progression to different levels.

United States of America:

America was chosen because they are the world's largest producer of fluid power components, with 2 of the largest manufacturing companies in the world (Parker and Eaton) having their corporate headquarters situated in Cleveland, Ohio. These companies have global manufacturing facilities and are represented in South Africa.

There are no mandated national standards for training fluid power technicians in the USA, however, ANSI/FPS/CS 1 specifies the testing procedures for the following career paths:

- Fluid power mechanic (as defined by the U.S. Department of Labour DOT 600.281-010).
- Fluid power technician (as defined by the U.S. Department of Labour DOT 007.161-026).
- Fluid power specialist (as defined by the U.S. Department of Labour DOT 007.061-014).
- Fluid power engineer.

Testing is conducted under the auspices of the Fluid Power Certification Board which shall be representative of manufacturers, distributors, users, educators and general interest groups, with no single category being in the majority. Written and practical tests are prepared by qualified fluid power professionals who are approved by the Fluid Power Certification Board.

The proposed National Certificates are similar to the USA standards in that they:

- Do not specify training requirements, but identify assessment criteria for competent performance at different levels in fluid power.
- Are specific to fluid power as an individual qualification.

The proposed National Certificates differ from the USA standards in that they:

- Do not have registered unit standards, but give broad requirements of competence, which are set by industry.
- There are no clear guidelines for progression from one qualification to another.
- The employers are responsible for determining levels of competence, except for the Fluid Power Engineer, who will be certified by the universities and state licensing boards.
- Certification is only valid for a period of 5 years, as specified by the Fluid Power Certification Board.

Japan:

Japan was selected because they are home to the largest pneumatic manufacturing company in the world (SMC). They also have a large original equipment manufacturer's market using pneumatic components for global distribution.

Japan has a National Trade Skill Test system which is certified by the government to test the technical skills and knowledge of working people according to uniform standards. This started in 1959 with five specific trades, and was expanded to 137 trades in 2004, including "Pneumatic circuits and apparatus devices assembling" and "Hydraulic systems". The National Trade Skill Test takes place annually and the applicants must take practical and theoretical tests. Upon passing the examination, the Minister of Health, Labour and Welfare or Prefectural Governor issues the successful applicants a diploma and a "Certified Skilled Worker" award.

The results of the National Trade Skill Tests may be graded as follows:

- Advanced grade Skills required for managers and supervisors.
- 1st grade or non-classified grade Skills required for advanced skilled workers.
- 2nd grade Skills required for intermediate skilled workers.

- 3rd grade Skills required for novice workers.

The course content was not available in English and therefore could not be evaluated in detail for comparison.

Germany:

Germany was selected because they are a major producer of fluid power components and systems and is home to, amongst others, the following companies that are represented in South Africa: Festo, Bosch Rexroth, Norgren-Herion, Parker Ermeto, Walterscheidt, Voss and Bürkert. Major innovations in hydraulics stem from Germany and are practically applied in South Africa.

It was identified that Germany does not offer qualifications specific to fluid power, but that they do offer generic mechanical qualifications with courses in hydraulics or pneumatics in agricultural, industrial and automotive fields. These are generally conducted through industry based apprenticeship training with a duration of 42 months, which may be shortened to as little as 2 years, depending on prior learning. Assessments for these trades are undertaken by the Regional "Industrie und Handelskammer".

Specialised courses are offered by employers to train candidates to industry requirements. Much of this training material has been adopted by South African companies in their training courses. Elements of the MERSETA accredited course in mechatronics is presented by Festo, and most of the training material for that qualification is from Germany.

Africa:

It was identified that Botswana, Zimbabwe, Zambia, Namibia, Swaziland, Mauritius and Malawi do not have specific qualifications in fluid power, but most generic engineering qualifications contain courses in pneumatics and hydraulics. International companies and local mining houses represented in those countries provide short courses to equip candidates with specific skills required for areas of involvement. Generally a tradesman (fitter & turner, maintenance technicians, etc.) is employed to conduct machine maintenance, which includes various elements of fluid power.

Training equipment and materials have been supplied to the African countries mentioned above by Festo and Parker in South Africa to assist in their training processes. Of these countries, Botswana appears to be the most advanced in this field with government funded vocational colleges, incorporating fluid power training in Gabarone, Jwaneng, Selebi Pikwe, Palapye, Francistown and Maun. Namibia has training centres in Windhoek and in Walvisbay. Mauritius has one training centre in Port Louis. Swaziland has one training centre on the outskirts of Mbabane. Training conducted in these countries is against the same international work standards used in South Africa in the past, and it is anticipated that this qualification will be useful in progressing the training conducted in these countries. Zambia, Zimbabwe, Malawi and Mozambique have little or no recorded public activity in this field due to current economic rebuilding.

ARTICULATION OPTIONS

This qualification has been designed and structured as part of a progressive route in the manufacturing and assembly processes industry so that qualifying learners can move from one level to the next. The use of generic unit standards in this qualification opens new avenues for the learner to progress from one qualification to another in related fields of study beyond fluid power. Employers or institutions should be able to evaluate the outcomes of this qualification against the needs of their context and structure top-up learning appropriately. Equally, holders of other qualifications may be evaluated against this qualification for the purpose of RPL.

This qualification leads directly to the National Certificate in Fluid Power: NQF Level 3. Learners may also decide to further their career in one of the following fields:

- Electrical engineering.
- Mechanical engineering.

Learners who have achieved this qualification have achieved generic skills that would enable them to follow a career in electrical or mechanical engineering. This qualification articulates with the following qualifications:

- National Certificate: Engineering and Related Design NQF Level 2.
- National Certificate: Introductory Mechanical Engineering NQF Level 2.
- ID 48473: National Certificate: Electrical Engineering NQF Level 2.
- ID 58722: National Certificate: Engineering Fabrication NQF Level 2.
- ID 23273: National Certificate: Mechanical Engineering: Fitting NQF Level 2.
- ID 48804: National Certificate: Occupational Safety, Hygiene and Environment NQF Level 2.

MODERATION OPTIONS

Moderators for the qualification should be qualified and accredited with an appropriate ETQA and have a suitable qualification in engineering with a minimum of 5 years experience in fluid power.

To assure the quality of the assessment process, the moderation should cover at least one of the following:

- Assessor credentials.
- The assessment instrument.
- The assessment process.

Where assessment and moderation are taking place in sectors other than the MERSETA, assessment and moderation should be in terms of a memorandum of understanding negotiated with the MERS ETQA.

CRITERIA FOR THE REGISTRATION OF ASSESSORS

- Appropriate qualification in the field of engineering, with a minimum of 5 years experience in the field of fluid power. The subject matter experience of the assessor can be established by recognition of prior learning.

- Appropriate experience and understanding of assessment theory, processes and practices.

- Good interpersonal skills and ability to balance the conflicting requirements of:

  - Maintaining national standards.
  - The interests of the learner.
  - The need for transformation and redressing the legacies of the past.
  - The cultural background and language of the learner.

- Registration as an assessor with the relevant ETQA.

- Any other criteria required by the relevant ETQA.

UNIT STANDARDS

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Core	115393	Assemble mechanical components	Level 2	12
Core	244690	Demonstrate basic knowledge of hydraulic components	Level 2	3

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Core	244691	Demonstrate basic knowledge of pneumatic components	Level 2	3
Core	244686	Demonstrate understanding of the principles of fluid power	Level 2	6
Core	244688	Identify hose and fluid power connectors	Level 2	3
Core	13136	Install, test, maintain and commission basic electrical circuits	Level 2	16
Core	13238	Mark off basic engineering shapes	Level 2	2
Core	12215	Read, interpret and produce basic engineering drawings	Level 2	6
Core	119744	Select, use and care for engineering hand tools	Level 2	8
Core	12476	Select, use and care for engineering measuring equipment	Level 2	4
Core	12219	Select, use and care for engineering power tools	Level 2	6
Core	9322	Work in a team	Level 2	3
Elective	116938	Use a Graphical User Interface (GUI)-based word processor to create and edit documents	Level 1	4
Elective	243069	Braze metals using the oxy-fuel brazing process	Level 2	6
Elective	13217	Collect and use information	Level 2	5
Elective	12218	Construct and test basic electronic circuits	Level 2	16
Elective	12465	Develop a learning plan and a portfolio for assessment	Level 2	6
Elective	12466	Explain the individual`s role within business	Level 2	4
Elective	13219	Maintain static seals in machines and / or equipment	Level 2	4
Elective	9268	Manage basic personal finance	Level 2	6
Elective	12484	Perform basic fire fighting	Level 2	4
Elective	12483	Perform basic first aid	Level 2	4
Elective	119753	Perform basic welding/joining of metals	Level 2	8
Elective	12463	Understand and deal with HIV/AIDS	Level 2	3
Elective	117924	Use a Graphical User Interface (GUI)-based word processor to format documents	Level 2	5
Fundamental	119463	Access and use information from texts	Level 2	5
Fundamental	9009	Apply basic knowledge of statistics and probability to influence the use of data and procedures in order to investigate life related problems	Level 2	3
Fundamental	12461	Communicate at work	Level 2	5
Fundamental	7480	Demonstrate understanding of rational and irrational numbers and number systems	Level 2	3
Fundamental	9008	Identify, describe, compare, classify, explore shape and motion in 2-and 3-dimensional shapes in different contexts	Level 2	3
Fundamental	119454	Maintain and adapt oral/signed communication	Level 2	5
Fundamental	7469	Use mathematics to investigate and monitor the financial aspects of personal and community life	Level 2	2
Fundamental	9007	Work with a range of patterns and functions and solve problems	Level 2	5
Fundamental	119456	Write/present for a defined context	Level 2	5

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UNIT STANDARD:

Demonstrate understanding of the principles of fluid power

SAQA US ID	*UNIT STANDARD TITLE*		
244686	Demonstrate understanding of the principles of fluid power		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	6

SPECIFIC OUTCOME 1
Demonstrate understanding of basic physics.

SPECIFIC OUTCOME 2
Demonstrate understanding of fluids.

SPECIFIC OUTCOME 3
Demonstrate understanding of fluid flow and pressure.

SPECIFIC OUTCOME 4
Demonstrate understanding of fluid power conversion to mechanical power.

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UNIT STANDARD:

Identify hose and fluid power connectors

SAQA US ID	*UNIT STANDARD TITLE*		
244688	Identify hose and fluid power connectors		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	3

SPECIFIC OUTCOME 1
Measure thread pitch.

SPECIFIC OUTCOME 2
Measure the size of a connector.

SPECIFIC OUTCOME 3
Determine sealing method of connector.

SPECIFIC OUTCOME 4
Identify standard fittings.

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UNIT STANDARD:

Demonstrate basic knowledge of hydraulic components

SAQA US ID	*UNIT STANDARD TITLE*		
244690	Demonstrate basic knowledge of hydraulic components		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	3

SPECIFIC OUTCOME 1
Demonstrate understanding of the different types of hydraulic components and their application.

SPECIFIC OUTCOME 2
Demonstrate knowledge of hydraulic circuit diagrams and symbols.

SPECIFIC OUTCOME 3
Describe the effect of various adjustments on fluid power components.

SPECIFIC OUTCOME 4
Describe safety aspects related to hydraulic systems.

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UNIT STANDARD:

Demonstrate basic knowledge of pneumatic components

SAQA US ID	*UNIT STANDARD TITLE*		
244691	Demonstrate basic knowledge of pneumatic components		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	3

SPECIFIC OUTCOME 1
Explain the operation of basic air service components.

SPECIFIC OUTCOME 2
Explain the operation of pneumatic valves.

SPECIFIC OUTCOME 3
Explain the operation of pneumatic actuators.

SPECIFIC OUTCOME 4
Explain the operation of pneumatic accessories.