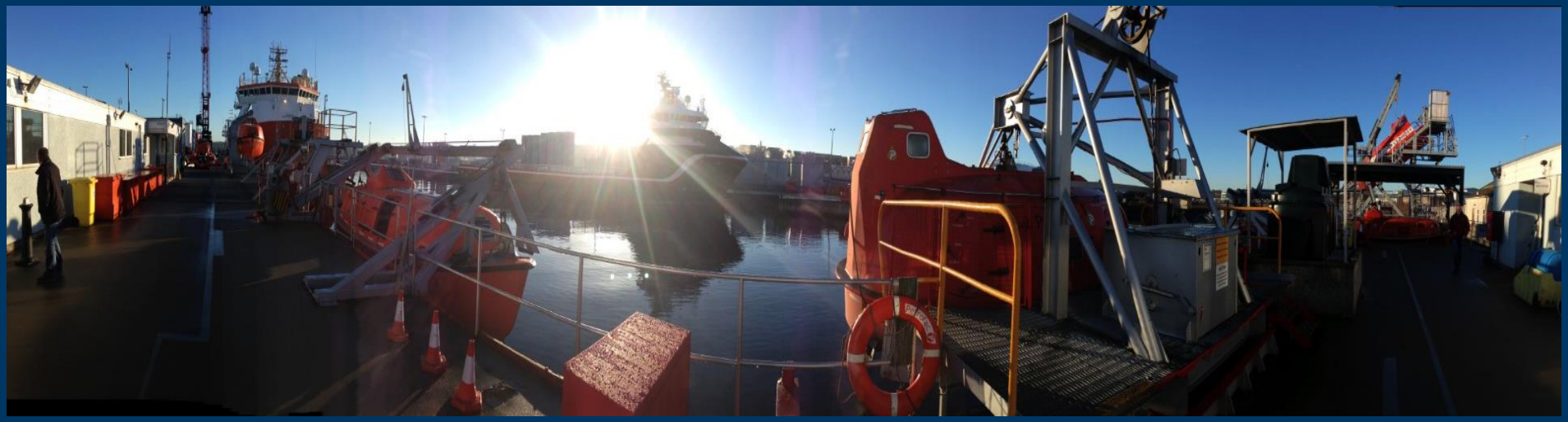
DEPARTMENT OF EMPLOYMENT AND LABOUR OCCUPATIONAL HEALTH AND SAFETY UNDERWATER CONFERENCE

20 - 22 NOVEMBER 2024



Diving Equipment Maintenance: What makes a future proof planned maintenance system

Rev 1.0 (2019)

Welcoming

Maintenance System Overview

Maintenance System

What makes a good maintenance system?

- **Management Commitment**
- Documented System
- Documented Procedures
- Competent Personnel
- Documented Equipment Register
- Detailed Inspection protocols - Including Acceptance and Rejection Criteria
- Sufficient Maintenance and Inspection Tools
- Available OEM Manuals and Instructions
- Sufficient Spares (OEM or Approved Alternatives)
- Service Level Agreements With External Service Vendors
- Contingency Planning (Personnel / Tools / Equipment / Spares)
- Regular Independent Audits and Reviews of System

Competence

Competence

What Do You Under Stand Under Competence?

Who Declares Competence?

Who Determines Requirements Competence?

Is Competence For Life?

What is Required in Order to Declare Someone Competent?

- **Organisation**
  - Documented Requirements and Minimum Outcomes
  - Provide Necessary Training & Resources
  - Continuous Monitoring
  - Declare Competence In Writing
- **Individual**
  - Meet Minimum Requirements
  - Have Sufficient Knowledge
  - Able to Perform Task - Safely
  - \- Without Assistance
  - \- Achieve Objective

"Someone who by virtue of their training or experience, or a combination of both, has such practical and theoretical knowledge and actual experience of the plant which has to be examined or tested as will enable him to detect defects or weaknesses which it is the purpose of the examination or test to discover and to assess their importance in relation to the safety of the plant."

Competence

Dive Technician Competence and Training

The level of training required and the level of competence for an individual will depend upon the complexity and range of equipment they are to work on

Why is Aptitude Important?

Formal Qualification / Training

- Electronics Technician
- Mechanical Engineering
- Hydraulic Engineering
- Electrical Engineering
- Marine Engineering
- Motor Vehicle Engineering
- Aviation Technician (Any Discipline)
- Agricultural Machinery Maintenance And Repair
- Plumbing
- Shipbuilding
- Telecommunications

Or

- Have Completed A Recognised Trade Apprenticeship In A Relevant Trade.

Competence

Dive Technician Competence and Training

Formal Tertiary Qualification

- Technical Trade Qualified Trade Test Completed
- Technical Diploma / National Higher Diploma (ECSA-Proffesional Engineering Technician)
- Engineering Degree (ECSA-Proffesional Engineer)

Dive Technician

Issue Of Technicians Logbook For Tracking Of Training And Competencies Completed

General Life Support Equipment Technicians Course	The Physics Of Diving Related Plant And Equipment Equipment Theory - Design And Construction Setting Up A Professional Workshop Working Practices, Standards And Procedures Regulator Service And Repair Basic Metallurgy Warranties And Customer Care Regulations And Standards
Compressed Air Systems Management Course	Working Practices, Standards And Procedures Compressors, Air Banks - Operation And Air Quality (CASM) Regulations And Standards
Oxygen Technician And Gas Blender Course	Clean And Prepare Diving Equipment For Use With Nitrox, Heliox And Tri-Mix Produce Nitrox, Heliox And Tri-Mix
Gas Booster System	Working Practices, Standards And Procedures Operation And Air Quality (CASM) Inspection And Maintenance
Cylinder Testing Technicians Course – Level 1	Working Practices, Standards And Procedures Cylinder Testing (Level 1) - Visual Inspection & Hydraulic Testing Valve Maintenance Thread Gauging Regulations And Standards
Basic Chamber Maintenance	Basic electrical systems Depth gauge calibration Door & window seals Lubricants, sealants & disinfectants Patient oxygen delivery systems Pressure regulators Pressure relief Pressure vessel testing Preventive maintenance
Gas System Installation	Working Practices, Standards And Procedures Connections And Fittings Material And Uses Inspection Particle filters
Gas Detection Systems	Properties Of Gasses Equipment Types And Advanatges And Disadvantages Maintenance And Inspection

Any Formal Technical Qualification As An Entry Point For Final Certification Combined With All Generic Field Technician Training Will Entitle Individual To Be Recognized As Life Support Equipment Technician

Additional Company Equipment Specific & Development Training

- Kirby Morgan
- ScubaPro
- APEKS
- POSEIDON
- AUQUALUNG
- MARES
- Colin Sub
- BAUER
- Cylinder Testing Technicians Course Part – Level 2
- Composite Cylinder Inspection & Testing Course
- Etc. OEM Specific
- Company Specific Competency Assessments

Courses to be decided by employer to be completed by individual as determined by actual equipment used to be deemed competent for specific project.
This is over and above Life Support Technician Training

Competence

Categories of Competent Person (IMCA)

Category 1

A diving or life support supervisor duly appointed by the diving contractor

- Competent to carry out or supervise a number of types of examinations and test but may not be appropriate for other tests unless he has had additional specific training.

Category 2

A technician or other person specialising in such work who may be an employee of an independent company, or an employee of the owner of the equipment

- His responsibilities should enable him to act independently.

Category 3

A classification society or insurance company surveyor, or Chief Engineer certificated

Category 4

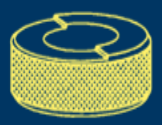
The manufacturer or supplier of the equipment, or a company specialising in such work which has, or has access to, all the necessary testing facilities

- This may also be a technician employed by the owner of the equipment provided that he has been fully trained and certified for the specific operation and has access to all necessary equipment and facilities.

Example








Inspection And Service

Detail Sheet 10.1 Seamless Gas Cylinders taken under water – (IMCA D018)

When new

Examination/Test	Category of Competent Person
Manufactured in accordance with a recognised international code or standard and fit for the purpose it will be used for	3 or 4

When in service

Examination/Test	Validity Period	Category of Competent Person
External visual examination	6 months	1, 2, 3 or 4
In addition, bail out bottles and suit/BCD inflation bottles should also have an internal visual examination	6 months	2 or 4
Thorough internal and external visual examination and gas leak test to maximum working pressure. If the competent person deems it necessary, a hydraulic overpressure test may be required	2.5 years	3 or 4
Hydraulic overpressure test to 1.5 times maximum working pressure (or the factor required by the design code or standard if different) plus the 2.5 yearly tests above	5 years	3 or 4

Note:

In many countries there are detailed national regulations concerning gas cylinders, particularly if these are transportable. Such regulations must be complied with, even if they conflict with or are more onerous than the recommendations given above.

If a hydraulic test has been carried out, it is important that confirmation is received that all moisture has been removed prior to the unit being put back in service.

Inspection And Service

Competence Declaration – Example Cylinder Inspector

Section 1 – Theoretical Knowledge Assessment

This section can be verbal or written and the result recorded in the applicable block. Any score of Not Yet Competent (NYC), will result in an overall score of NYC for this section, resulting in the individual having to receive additional coaching, and re-assessed at a later time, when the required knowledge has been obtained. Copies of the answers or summary when done verbally should be kept together with this sheet on the individual's personal folder. The correctness of the theoretical knowledge shall be assessed against a recognised training manual or predetermined answer sheet.

Requirements		Score C	Score NYC	Score N/A
1.	What Regulations and standards have to be complied with for the inspection of cylinders?			
2.	Describe requirements to be appointed as an Inspector in terms of the Gas Test Station			
3.	What documents are you required to fill in at your facility during an inspection?			
4.	Where do you find the operating procedures for the inspection equipment?			
5.	Who is authorised to operate and use this equipment?			
6.	What are the operating specifications for your hydrostatic pressure test system?			
7.	Describe in detail the systems at your facility.			
8.	Identify all the inspection tools required to perform an inspection and for what process it is required.			
9.	Identify all the inspection equipment that could influence the results of an inspection.			
10.	What needs to be inspected on the Hydrostatic system prior to operating it?			
11.	What Considerations should be given to a Fixed system?			
12.	What Considerations should be given to a Portable system?			
13.	Who is responsible for the maintenance of the test system?			
14.	Describe correct use of flexible hoses			
15.	Describe and explain possible system faults with corrective action.			
16.	Describe conditions that will require the system to be shut down.			
17.	Who are equipment defects reported to?			
18.	Who are any concerns relating to the inspection of a cylinder reported to?			
19.	How are any Safety concerns addressed?			
20.	Describe control procedures that is available and in place to ensure quality, consistency and repeatability.			
21.	Describe traceability, in relation to reference Standards and Documentation			
22.	Describe traceability, in relation to Measuring and inspection equipment			
23.	What need to be considered during identifying cylinders for inspection as per the facility's SOA and associated Standards / Work Instructions and where can the information be found?			
24.	What additional considerations needs to be accounted for when receiving a DOT specification cylinder for inspection.			
25.	What is required to be inspected and verified on a cylinder prior to accepting it for inspection?			
26.	What rejection criteria would cause you not to accept a cylinder for inspection?			
27.	What considerations need to be giving for preparing cylinders for inspection as per the facility's SOA and associated Standards / Work Instructions.			
28.	What is the proper procedure and requirements for de-pressurizing cylinders to render them safe for inspection, as per the facility's SOA and associated Standards / Work Instructions and where can the information be found?			

Section 2 – Practical Performance Assessment

This section must be witnessed by the assessor and the result recorded in the applicable block. Any score of Not Yet Competent (NYC), will result in an overall score of NYC for this section, resulting in the individual having to receive additional coaching, and re-assessed at a later time, when the required skills has been obtained.

To satisfy the specific requirement, the individual will be required to meet the following criteria:

1. Perform requirement ***safely***
2. Perform requirement ***un-aided and without involvement by assessor***
3. Perform requirement ***achieve the desired objective***

Requirements		Score C	Score NYC	Score N/A
1.	Ability to communicate both verbally and in writing in English.			
2.	Ability to use correct terminology, both verbal and in written in English, pertaining to gas cylinder vocabulary.			
3.	Ability to write memos, inspection reports and instructions both by hand and electronically.			
4.	Ability to locate operating instruction, procedures, standards, and forms.			
5.	Ability to correctly fill in and use all documents and forms.			
6.	Ability to ensure the safety of personnel in the operating area of the equipment.			
7.	Ability to read and interpret calibration certificates.			
8.	Ability to be understand and maintain the different pressure regimes.			
9.	Ability to ensure a safe testing area.			
10.	Ability to identify cylinders that can be inspected by facility.			
11.	Ability to identify markings and special requirements on various types of cylinders.			
12.	Ability to conduct a pre-use check, identifying that the equipment is in good operational condition.			
13.	Ability to perform in-service checks on equipment that can have an influence on results.			
14.	Ability to prepare cylinders for inspection and testing.			
15.	Ability to depressurise and de-valve cylinders for inspection.			
16.	Ability to identify and handle a blocked valve.			
17.	Ability to perform an external cylinder inspection.			
18.	Ability to perform an internal inspection.			
19.	Ability to perform a neck thread inspection on parallel and tapered threaded cylinders.			
20.	Ability to ensure this equipment is only operated by qualified personnel.			
21.	Ability to ensure this equipment is operated as per operating instructions.			
22.	Ability to confirm functionality of the safety systems.			
23.	Ability to run systems at correct pressure.			
24.	Ability to perform a hydrostatic pressure test using proof test method.			
25.	Ability to perform a hydrostatic pressure test using volumetric expansion test method.			
26.	Ability to make system safe on completion of task.			
27.	Ability to perform the cleaning of cylinders of various types of materials.			
28.	Ability to perform drying of cylinders after testing or cleaning.			

Inspection And Service

Detail Sheet 10.1 Seamless Gas Cylinders taken under water – (IMCA D018/SANS10019)

When in service

Examination/Test	Validity Period	Category of Competent Person
External visual examination	6 months	1, 2, 3 or 4
In addition, bail out bottles and suit/BCD inflation bottles should also have an internal visual examination	6 months	2 or 4
Thorough internal and external visual examination and gas leak test to maximum working pressure. If the competent person deems it necessary, a hydraulic overpressure test may be required	2.5 years	3 or 4
Hydraulic overpressure test to 1.5 times maximum working pressure (or the factor required by the design code or standard if different) plus the 2.5 yearly tests above	5 years	3 or 4

Table G.3 — Intervals for periodic inspection and testing of pressure receptacles used for breathing gasses in the SCUBA and SCBA industry

1	2	3
Description of gas type	**Example of pressure receptacles by gas type**	**Frequency of pressure receptacle inspection and testing[a]** years
Compressed gases	Self-Contained Breathing Apparatus air	2 year internal, 4 year hydrostatic test
	Gases for Self-Contained Underwater Breathing Apparatus	2 year internal, 4 year hydrostatic test

Inspection And Service

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Note:

- These test periods should be used provided the dryness of the product and the filled cylinder is such that there is no free water. This condition should be proven and documented within the quality system. Evaluation of these conditions can indicate that alternative or more frequent testing may be appropriate.

- The frequencies given in this table indicates the maximum time interval between inspections, and supersedes any more lenient intervals in referenced standards.

- Maritime use cylinders should be inspected and filled in terms of the requirements of IMO, by an approved relevant national authority (see foreword) facility approved for the specific services – Proof of final owner/vessel to be retained by the facility.

7.1 General (SANS10019:2023)

Only an approved test station shall carry out periodic inspection and testing (revalidation) of pressure receptacles.

Such inspection and testing shall be in accordance with SANS 1825.

Inspection And Service

Reference Documents

Cylinder certificate of manufacture

Cylinder importer's declaration of conformity

Valve manufacturing certificate

Valve parts diagram and maintenance requirements

Relevant Inspection Standards:

- SANS-347 (Categorization and conformity assessment criteria for all pressure equipment)
- SANS-10019 (Transportable pressure receptacles … — Basic design, manufacture, use and Maintenance)
- SANS-1825 (Gas cylinder test stations — General requirements for periodic inspection and testing …)
- SANS-18119 (Seamless steel and seamless aluminium-alloy gas cylinders — Periodic inspection and testing)
- ISO-22343 (Gas cylinders - Inspection and maintenance of valves)
- ISO-13341 (Gas cylinders - Fitting of valves to gas cylinders)

Documentation & Records

Documentation & Records

All examinations and tests carried out need to be documented in order to demonstrate in the future exactly when they were carried out, by whom and exactly what work was carried out.

Major Test or Examinations

Sort of tests carried out at extended intervals such as annual wire rope tests or five yearly pressure tests. These will in most cases be carried out or witnessed by a third party who will issue a formal certificate often authenticated with a stamp or similar marking.

Regular Examinations and Test

tests and examinations carried out at regular intervals (normally six months or less) and which may often be carried out by the diving or life support supervisors or one of the technicians employed by the diving contractor.

Documentation & Records

Planned Maintenance Systems (PMS)

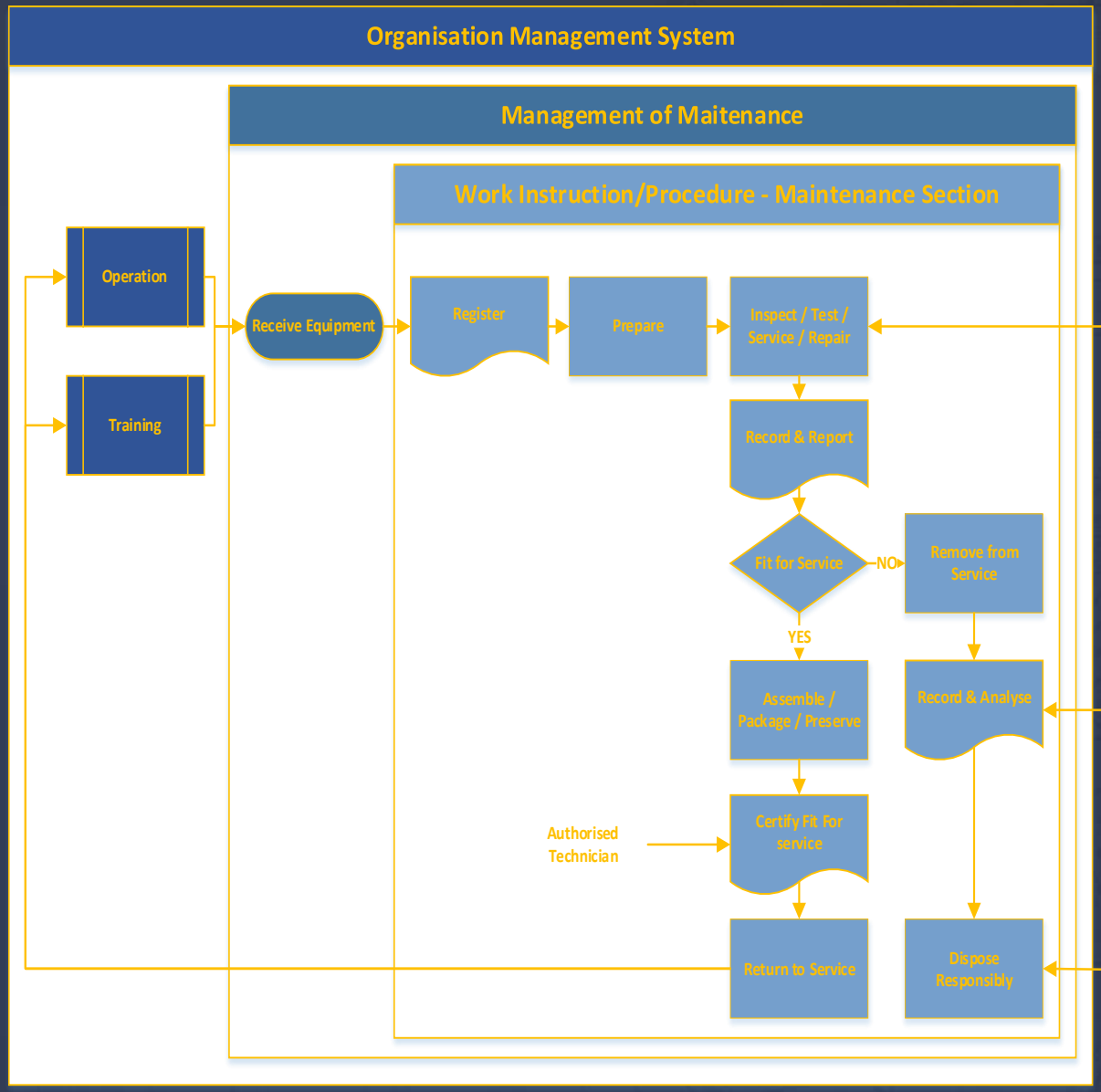
Whichever system is used provision must be made for the following:

- Inclusion of manufacturers' recommendations and manuals, where appropriate
- Compliance with the requirements of this document where some types of certification is achieved by means of the PMS
- Record of planned work to be kept showing each item of maintenance and the interval at which it should be maintained, i.e. daily, weekly, monthly, yearly, etc.
- Record of unplanned work, including repairs
- Traceability to the person who carried out the work as recorded on an item of equipment whether manual or computer systems are employed
- Records to be kept logically. There should be no doubt on which day maintenance has been carried out and by whom
- Ensuring that maintenance which has been delayed on a particular piece of equipment for any reason, is carried out at the first available opportunity to avoid a hazardous situation arising
- Availability of adequate spares to permit routine and non-routine replacement as necessary.

Conclusion

Conclusion

- Management
- System
- Equipment
- Resources
- People
- Training
- Documentation
- Details
- Recall / Historical Data / Archiving
- Review Effectiveness



Conclusion

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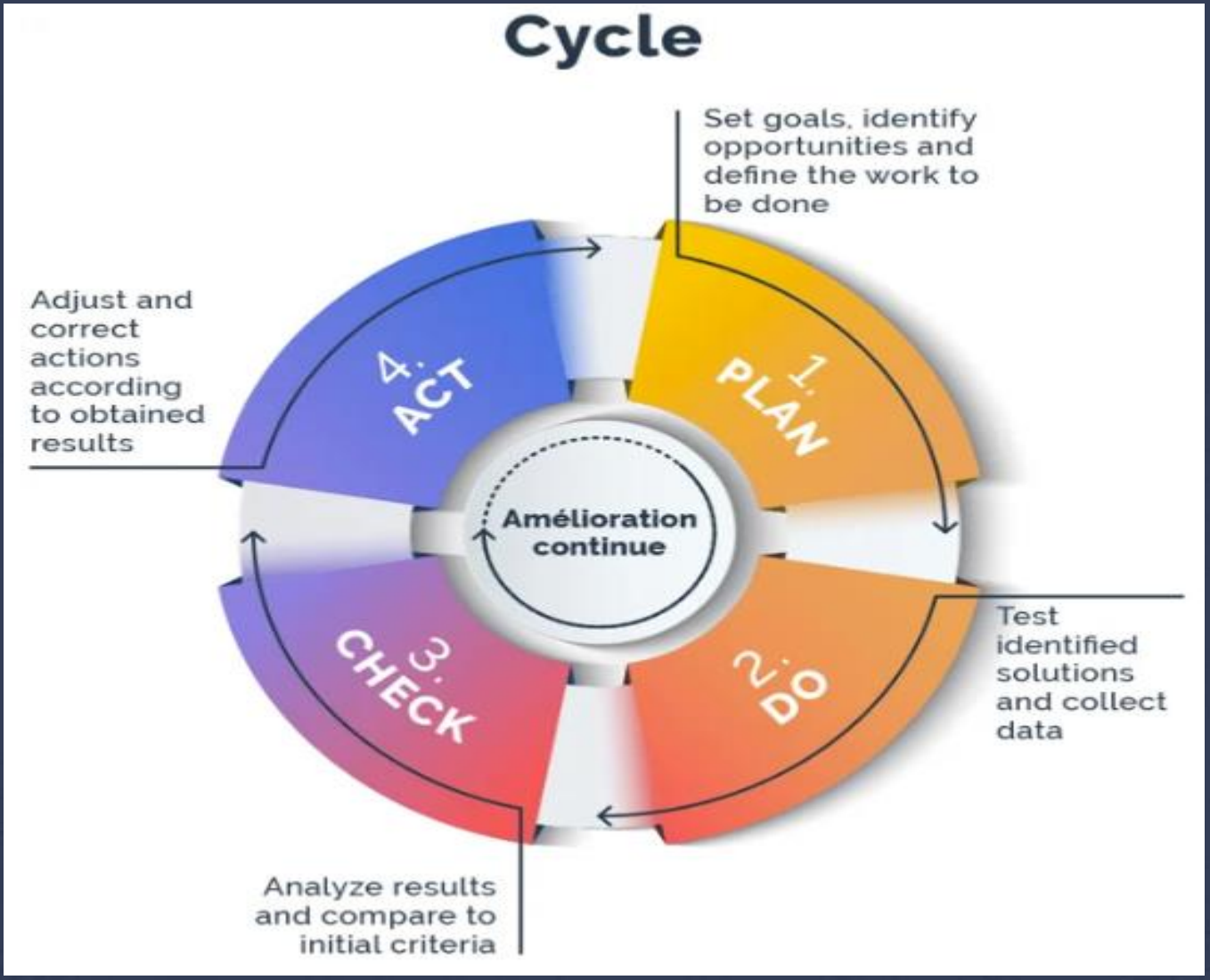
Conclusion

P-D-C-A




THANK YOU