South African Qualification and Certification Committee (Corrosion Protection)

APPENDIX P1

SYLLABUS

MODULE PI

PAINT INSPECTOR COURSE

This syllabus incorporates elements from the old level 1 & level 2 courses as well as including new material. The revised syllabus also removed portions of the old course, where the knowledge was deemed not to be necessary for a paint inspector to perform his minimum job requirements.

All *test and inspection procedures should be to SABS or SANAS standards. Where not available then the applicable ISO Standards can be used.*

A copy *of all referenced standards used in the training should be attached to the course theoretical notes.*

Duration
The planned duration is a 5 day course with the exam on the 6th day - 40hrs training.
Lecture time and notes must be spread across all topics evenly and in equal proportions.
Theory in the mornings ±25 hours (08h00 to 13h00) (5hrs per day for 5 days).
Self study and tutorial questions and quiz each morning on previous day's session.
Practical training planned in the afternoons after lunch. The practical training should be repetitive with all students getting repeated opportunity to use the instruments.

The minimum entrance requirement for students sitting the course is literacy, to have passed a South African Standard 8 or Grade10 ABET Level 5 must be written exam equivalent schooling, or have at least 5 years relevant involvement in the protection coatings industry.

INTRODUCTION

i COURSE OBJECTIVE
ii COURSE OVERVIEW
iii DECLARATION OF ETHICAL, HONEST AND FAIR BEHAVOUR AND DISCIPLINARY PROCEDURES
iv REGISTRATION FORM
Before starting the course, this declaration must be signed and handed in. A copy of the declaration wording remains in the file.

1 Hour

1.0 INSPECTION PROTOCOL & METHODOLOGY **Self Study**

- Pre-agree application conditions and application methods, before first inspection.
- Pre-agree pass/fail criteria before first inspection.
- Pre-agree controlling specification for project – in the event there are no formal documents or interpretation, there is potential for ambiguity and dispute.
- Pre agree template report document.
- Pre agree template Quality Control Plan (QCP or Inspection & Test Plan (ITP).
- Pre agree who will sign off on the final quality acceptance of the job, before the job starts.
- Pre agree if inspector has delegated authority to stop the job, or if he must only record defects and report problems.
- Assembly of all necessary equipment and all necessary documentation.
- Make sure inspector' instruments are calibrated before going to site.

1.1 Preparation for inspection visit **20 mins & Self Study**

- Knowledge of location of site.
- Communication with site personnel.
- Ascertaining site rules, eg safety requirements, security regulations, working times.
- Register arrival with relevant parties.
- Meet to plan time spent on site, eg survey of QA records, progress up-date – set visit agenda.
- Inspection of work as per agenda.
- Importance of presence of contractor(s) representative during inspection.
- Recording and marking of defective work.
- Release of satisfactory work.
- Communication of results of inspection to relevant parties.
- Setting program for next site visit.

Note: Site can mean contractor's yard or site operation.

1.2 Interpretation of specifications **25 mins & Self Study**

Note to Course Writers: *Two situations commonly arise – formal specifications and ad hoc specifications.–the inspector should be involved before the project commences, but often he is not. When a project goes wrong the inspector may be sent in to do damage control and the syllabus writers need to take cognisance and incorporate this into the inspector' training.*

- In situations where there is no formal specification or the specification is very brief and incomplete or situations where the paint sales representative's recommendation has been adopted as the specification. The inspector must be trained on how to deal with informal or incomplete specifications.
- Larger projects generally have more formalised or detailed specifications, often generated by third party consultants or knowledgeable anti-corrosion experts and in these cases the inspector must be trained on how to interpret the specifications and how to get agreement between the client, the contractor and various other parties on interpreting the specification.
- Re-use of pre-existing specifications that may not be appropriate for the project. The inspector needs to be trained to highlight potential problems where a specification is not appropriate to the site conditions or inappropriate application techniques or geometry constraints such in a trench or only hanging rope access. In such cases the inspector needs to be trained on how to properly refer the

specification, through the chain of command, back to the relevant consultants/project managers or asset owners for amendment of the specification.

1.3 Control of quality during inspection **Self Study**

- Ascertaining client's Quality Assurance (QA) expectations.
- Ascertaining main contractor's QA expectations.
- Ascertaining painting contractor's QA system.
- Ascertaining inter-relationship of various inspection authorities.
- Communication with contractor and client (reporting).
- Ascertaining None-conformance Reports (NCRs) and problem areas.
- Quality rejection will result in program delays.
- Clarification from authority on whether quality or urgency of program has the higher priority.
- Obtaining site inspection records of areas to be inspected as verification that areas have been completed.
- Reading and understanding quality plan in relation to the specification.
- Resolving disputes by comparing calibration of the various QC instruments used by inspectors and contractors.

1.4 Conditions during applications **10 mins each point & Self Study**

- Differences between shop and yard conditions.
- Interference from other contractors.
- Co-ordination of painting with other contractors and allied trades activities.
- Risk of weather delays to program.

2.0 BASIC CORROSION **Self Study**

Natural process of steel reverting to iron ore **10 mins**
Corrosion cell and components **15 mins**
Corrosion cell on a single surface **10 mins**
Corrosion control by breaking cell continuity **15 mins**
Corrosion environments (ISO12944-C1-C5)

- Atmospheric
- Buried } **10 mins**
- Submerged
- MIC (where it is found) **15 mins**

Note to Course Writers: (Other types of corrosion training are not deemed necessary for paint inspectors and beyond the scope of this course)

3.0 SURFACE PREPARATION **Self Study**

3.1 Welding (limited in scope as to how it affects paint application)

- Porosity
- Penetration } **10 mins**
- Undercut
- Underfill /Overlap
- Laminations, seams and laps
- Surface cracks
- Profile height of weld bead } **10 mins**
- Arc strikes and splatter

3.2 Fabrication Defects (limited in scope to how it effects paint application)

- Burrs.
- Edges.
- Flame Cutting.
- Radius of edges.

15 mins

3.3 Fabrication Design (ISO12944 Part 2) **2 hrs 10 mins**

- Back to back angles. **5 mins**
- Rat holes. **5 mins**
- Inverted channels. **5 mins**
- Bolts assemblies and flanged joints. **5 mins**

3.4 Surface Contaminants **Self Study**

- **Soluble Salts**, what they are and where to expect them.
  - Different test methods to identify soluble metallic salts. **25 mins**
  - Guidelines on maximum salt limits in the absence of manufacturers' data. **15 mins**
  - Different methods to decontaminate salts. **20 mins**
- **Oil and grease**
  - Solvent Cleaning. **10 mins**
  - Water soluble degreasers. **10 mins**
  - Test methods for oil. **10 mins**

3.5 Concrete

- Off shutter. **5 mins**
- Plaster. **5 mins**
- Porosity. **5 mins**
- 28 day concrete curing times. **5 mins**
- Cracks hairline & structural.
- Concrete Surface Preparation.
  - Scable.
  - Scarify.
  - Grit Blast. **5 mins**
  - Acid Etch. **5 mins**

3.6 Steel grades **Self Study**

- Hot and cold rolled. **10 mins**
- Mill scale degradation. **10 mins**

3.7 Surface preparation by Chemical Means

- Alkali degreasing. **5 mins**
- Acid pickling. **5 mins**
- Rinsing and neutralizing. **5 mins**
- Surface conversion processes. **10 mins**

3.8 Abrasive blast cleaning equipment

- Open nozzle. **10 mins**
- Wheel-abrader. **10 mins**
- Oil & water traps. **10 mins**

3.9 Abrasive blast cleaning **Self Study plus classroom time**

- **Air blast cleaning**
  - Blasting equipment. **10 mins**
  - Air pressure. **10 mins**
  - Blasting media – angularity/size relative to required profile. **10 mins**
  - Cleaning Standards. **15 mins**
  - Surface profile. **10 mins**
  - Dust & debris. **5 mins**
  - Soluble Salts – Test methods for salts. **5 mins**
- **Water blast cleaning** **Self Study plus classroom time** **3 Hours**
  - Various high pressure cleaning methods up to UHP. **5 mins**
  - Inhibitors. **5 mins**
  - Water Jetting. **5 mins**
  - NACE reference pictorial standards.
    - Low pressure.
    - High pressure.
    - Ultra high pressure.
    - Corrosion Inhibitors. **5 mins**

3.10 Blasting Media

- Disposable abrasives.
  - Platinum Slag.
  - Copper Slag.
  - Shot.
  - Grit.
  - Other media.
- Inspection of re-cycled blast media. **10 mins**
- Contamination: oil, grease, soluble salts, paint, dust, clay etc. **10 mins**
- Risks for inspectors to be aware of when grit is re-cycled. **5 mins**
- Other.

3.11 Level of Cleanliness (visual) (ISO 8501 – Degree of cleanliness)

- Ferrous. **5 mins**
- Formal definitions for blast cleanliness, wording versus pictorial standards. **10 mins**
- Elaboration on what is SA2.5. **10 mins**
- Non ferrous materials/passive films. **5 mins**
- Stainless Steel. **5 mins**

3.12 Profile

- Pin-type – **10 mins**
  <u>Note to course writers</u>:
  Please make sure that on the old Elcometer 123 there are two scales (red and black) and that the reading is read on the RED scale.
- Depth profile. **10 mins**
- micrometer gauge (Testex). **10 mins**

3.13 Manual Surface Preparation (ISO 8501 – including St1, St2, St3)

- Hand & mechanical cleaning. **10 mins**
- Wire brushing. **10 mins**
- Flame cleaning. **10 mins**
- Non–sparking tools. **10 mins**

4.0 COATINGS

Self Study plus classroom time **2 hrs 5 mins**

Note to Course Writers: *The Inspector is to understand the different curing mechanisms, pot lives, curing times and to understand the paint or coating material's characteristics that will be important from an inspector's perspective.*

The inspector is not to be trained to be an expert consultant on coating types, only the potential risks that an inspector needs to be aware of.

Discussion on concerns for common coating types that an inspector will be exposed to, with emphasis on curing mechanisms, overcoating time intervals, curing times, reparability, criticality of DFTs relative to surface profile, risk of flash rusting, blast quality deterioration over time, typical pitfalls for the inspector to be aware of.

4.1 Types of Coatings

- Non convertible **5 mins**
- Convertible **5 mins**
- Solvent based liquid coatings **5 mins**
- Solvent free liquid coatings **5 mins**
- Powder coatings, FBE, HDPE, PP, PE **5 mins**
- Emulsion based coatings **5 mins**
- Alkyds (enamel) **5 mins**
- Epoxy coatings (solvent free, solvent based and powder) **5 mins**
- Polyester coatings & Fibreglass (catalyst cured) **5 mins**
- Glass flake reinforced coatings
  - Polyester Glassflake coatings **5 mins**
  - Epoxy Glassflake coatings **5 mins**
  - Vinyl ester Glassflake coatings **5 mins**

4.2 Primers

- Sacrificial **5 mins**
- Inhibitive **5 mins**
- Barrier **5 mins**

4.3 Under Coats / Intermediate Coats

- Film build **5 mins**
- Barrier coats **5 mins**

4.4 Top Coats

- Decorative, UV resistant **5 mins**
- Communicative (colour coding) **5 mins**

4.5 Coating Constituents

Note to Course writers: *Limited relevance for an inspector and therefore overview only is required of coating constituents/paint formulation)*

- Ingredients of coatings and their function, including: **10 mins**
  - Pigments
  - Extenders
  - Binders
  - Additives
  - Solvents
    - Solvent levels.
    - Solvent types.

4.6 Solvent based paints

- Advantages and risks from an inspection perspective. **15 mins**

4.7 Solvent free products

- Advantages and risks from an inspector's perspective. **15 mins**

4.8 Number of coats **Self Study** **2 hrs 10 mins**

- **Volume Solids –** WFT / DFT / Shrinkage. **10 mins**
  Spread Rates.
  Effect of solvent addition on spread rates and stripe coating. **10 mins**
- **Edge Coverage**
  - How edge shrinkage increases with lower volume solids. **10 mins**
  - Stripe coating. **10 mins**
  - How stripe coating is progressively more important with lower DFTs per coat or low wet film builds.
  - Edge retentive coatings / non-shrink coatings. **10 mins**
  - Concessions relating to stripe coating techniques and risks. **10 mins**
- **Multi-coat systems**: Advantages and risks from an inspection perspective.
  - Generic & Solvent compatibility, intercoat times minimum and maximum over coating times, solvent entrapment, intercoat contamination, intercoat adhesion, amine bloom etc. **20 mins**
- **Single coat systems** : Advantages and risks from an inspection perspective
  - Pinholes, importance of holiday detection, criticality of minimum DFT, high film build per coat, number of labour operations to monitor, level of cosmetic finish required etc. **20 mins**

4.9 Epoxies

In recent years epoxy use has increased dramatically in the paint industry necessitating more focus on what inspectors need to be aware of when working with these materials.

- **Surface chalking**, what is it, how detrimental is it, chalking rates, Over coating chalked surfaces, UV resistant top coats. **15 mins**
- **Amine bloom of epoxies** what is it, when does it occur, when is it detrimental, how to detect it, how to remove it. **15 mins**

5.0 COATING APPLICATION

5.1 Spray

- Conventional **10 mins**
- Airless **15 mins**
- Plural component (in-line mixing or at gun catalysing). **10 mins**
- Brush **5 mins**
- Roller **5 mins**

5.2 Hazards

Self Study plus Class room time **1 hr 50 mins**

- Fire Hazards **5 mins**
- Health Hazards **5 mins**

5.3 Spray equipment

- Equipment type **5 mins**
- Nozzle size **5 mins**
- Pressure **5 mins**

5.4 Drying, curing and overcoating

- Touch
- Handle
- Overcoat (minimum and maximum intercoat time intervals). **5 mins**
- Full cure. **5 mins**
- Differences of step-wise polymerisation vs random polymerisation and how this affects the criticality of curing times from an inspector's perspective. **5 mins**

5.5 Environmental conditions during paint application

- Psychometric Test Methods (Theory & Practice). **15 mins**
- Ambient temperature.
- Surface temperature.
- Relative Humidity.
- Dew Point.
- Adverse weather conditions, eg. wind and rain. **5 mins**

5.6 Environmental effects on Curing and Drying

Overview of the differences between drying, curing and polymerising.

- Inhibition of cure, eg. rain on wet paint. **5 mins**
- Incomplete cure due to dry conditions, eg Inorganic Zinc and moisture cure Urethane. **5mins**
- Surface degradation during cure, eg dust, rain, chemical spills. **5 mins**
- Suspension of polymerisation due to low temperatures. **5 mins**
- Immersion before complete polymerisation. **5 mins**

5.7 Two-pack Mixing

Self Study **1 hr 10 mins**

- Induction. **5 mins**
- Pot life. **5 mins**
- Criticality of mix ratios. **5 mins**
- Risks when splitting kits. **5 mins**
- Volumetric or weight ratios. **5 mins**
- Generic types of coating where cure and pot life can be changed by varying the mix ratio. **5 mins**
- Generic types of coating where changes to the mix ratio are not permitted. **5 mins**

5.8 Storage of Paints **5 mins**

5.9 Batch Numbers **5 mins**

5.10 Coating Application Defects

- Sags, runs, tears, curtaining **5 mins**
- Lifting
- Pinholes
- Measle corrosion **5 mins**
- Alligatoring
- Blistering
- Cissing (fish-eye) **5 mins**
- Cracking and checking
- Bleeding
- Mud Cracking **5 mins**
- Orange Peeling
- Overspray
- Dry spray

6.0 HOT DIP GALVANISING AND DUPLEX COATINGS **Self Study** **2 hrs 40 mins**

- The Galvanising process (short overview). **10 mins**
- Typical galvanised zinc thickness. **5 mins**
- Duplex Coatings (wet applied and powder coatings). **15 mins**
- Surface preparation for duplex coatings methods. **5 mins**
- Difficulty of doing sweep blasting on galvanised surfaces without partially removing zinc layer. **5 mins**

7.0 PIPE LININGS (Including SANS 1217)

An overview of pipe lining systems internals) including:

- Solvent borne epoxies. **10 mins**
- Solvent free epoxies – Please cover adding thinners to solvent free epoxies. **10 mins**
- Flexible epoxies with or without reinforcement **5 mins**
- Solvent free rigid polyurethane. **5 mins**
- Solvent free Polyester. **5 mins**
- Solvent free Vinyl ester. **5 mins**
- Cement Mortar. **5 mins**

8.0 PIPE COATINGS (Including SANS 1217)

8.1 An overview of pipe coating systems (externals) including:

- Bitumen fibreglass – SANS 1178. **5 mins**
- Fusion bonded epoxy. **5 mins**
- Hot applied plural spray liquid epoxy. **5 mins**
- Fusion bonded medium density polyethylene plastic - Sintakote. **5 mins**
- Tape wrapping systems. **5 mins**
- 3-layer polyethylene. **5 mins**
- Rigid polyurethane coatings. **5 mins**
- Polyester glass flake coatings **5 mins**
- Pipe field joint coatings and compatibility with mainline coating **5 mins**

8.2 Pitfalls for inspectors on pipe coating projects

- Abrasive break down and loss of blast profile as the shift progress's due to recycling on wheel abrader requiring daily make up of 5% fresh grit into wheel abrader. **5 mins**
- Triangular void space found under tape wrapping system overlap edges, how to minimise tape wrap defects. Pipe size limitations. **5 mins**
- Difficulty in keeping track of pipes and need for each pipe to have a unique number. **5 mins**
- Trenches too narrow for spray or tape wrap. **5 mins**
- Impracticality of clean conditions and lack of good surface prep for field joints. **5 mins**
- Impracticality of field joint coating using the shop coating specification. **5 mins**

9.0 INSPECTION METHODS FOR COATINGS LININGS **Self Study plus class room practical time 2 hrs**

9.1 Inspection Methods **1 Hour**

- Cure: SANS 1217 only covers the dynamic test.
- Rub Tests. To which spec or test method.
- Barcol Hardness Tests. **15 mins**
- Shore Hardness Tests.
- Wet Film Thickness (WFT). **15 mins**
- Dry Film Thickness (DFT).
- Pinhole (Holiday) (EID) tests. **15 mins**
- Low Voltage Wet Sponge Testing.
- High Voltage Spark Testing. **15 mins**
- Adhesion Tests (direct stress pull, cross cut, cross hatch) – do practical pull off tests and demonstrate examples. **1 hr 15 mins** **15 mins**
- Calibration, operation and care of equipment. **5 mins**
- Health and safety awareness. **2 mins**
- Psychrometric conditions / Bichrometric conditions / Dew Point / Relative Humidity. **15 mins**
- Oil Checks. **2 mins**

9.2 Documentation

- Discuss examples of good documentation.
  - QC & ITP. **5 mins**
  - Log Book.
- Template Quality Control Plan (QCP) or Inspection & Test Plan (ITP). **5 mins**

If there are no project specific QC documents, then inspectors are allowed to use the SAQCC template document QCP or ITP.

9.3 Inspection & Testing

9.3.1 During Coating

- Surface Preparation. **2 mins**
- Overcoating times. **5 mins**
- Record of batch numbers and product codes. **2 mins**
- Correct mixing procedures. **2 mins**
- Working condition of equipment.
- Suitability of equipment.
- Quality of workmanship. **5 mins**
- Wet Film Thickness (WFT) measurement. **5 mins**
- Drying conditions with respect to painting. **5 mins**

9.3.2 Quality of Applied Coating
- Under thickness.
- Over thickness.
- Correct thinners usage. **5 mins**
- Sags, runs, tears, curtaining bubbling. **5 mins**
- Lifting, wrinkling, bleeding. **5 mins**

9.3.3 Completed Coating
- Dry film thickness (DFT) – Under thickness/Over thickness. **5 mins**
- Adhesion (to substrate and intercoat adhesion). **5 mins**
- Correct number of coats. **5 mins**
- Electric Insulation Defect (EID/Pinhole/Holiday) detection. **5 mins**
- Appearance, drying and curing. **5 mins**

9.3.4 Re-inspection of previously rejected work **5 mins**

9.3.5 After Inspection Procedures
- Recording of results.
- Communication with relevant parties.
- Issuing of NCRs, concession requests and release certificates. **25 mins**
- Copies to relevant parties.
- Arrangements for next visit.

10.0 PRACTICAL EXAMINAT*/*ON

Assessment of Surface Preparation (Primed Surface)

DFT instrument calibration
- Agreeing calibration methods

DFT measurements & DFT Statistics
- Variations in instrument's measurements

Adhesion Evaluation
- Cross Cut / Cross Hatch
- Tensile Pull-off Test using glued dolleys
- Peel pull adhesion test for rubber and elastomers,

Ability to write report describing
- DFTs
- EIDs
- Adhesion
- Appearance
- Paint film defects

Note to course writers and presenters that the inspectors must Demonstrate ability to find pinholes with both wet sponges and High voltage spark testers:
- *Please demonstrate tracking and causes*
- *Demonstrate the ability to identify false alarms with HV testers*
- *Demonstrate the correct wetness of the sponge during testing and problems associated with too dry or too wet sponges.*

Inspectors to be proficient with the following skills

1. **Set up and use of High Voltage Spark Tester**
2. **Detection of EIDs (Pinholes/Holidays) techniques**
3. **Advantages and disadvantages of spark testers versus wet sponge testers**
4. **Schematic paint defects in cross section showing potential versus actual defects**
5. **Limitation of wet sponge testers inside pipe and on vertical tank walls.**
6. **Practical examination of destructive pull-off dolleys, pre-prepared samples**
7. **Measuring of dew point, relative humidity, surface temperature, coating temperature.**
8. **Understanding the formal definitions for dew point**
9. **Salt testing**
10. **Profile measurements:**
    - Testex.
    - Pin-type.

11.0 MINIMUM EXAMINATION MARKS REQUIRED

To qualify as an SAQCC inspectors, the candidates shall be required to obtain the following minimum examination pass marks for BOTH exams:

Theoretical Examination: 60%

Practical Examination: 80%

12.0 PERIOD OF VALIDITY OF CERTIFICATE

The certificate shall not have an expiry date but will indicate that the candidate met or exceeded the requirements set by the SAQCC and the assessment performed by the SAQCC examiner on a particular date

Note: Duration of subject lecture time is only a guideline

A minimum of 2 hours self study is recommended for on each day's lectures and prior knowledge of the paint and coating industry is a requirements.

Training materials shall have a Glossary of terms (as an appendix)