Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

ANNUAL INSPECTION GUIDE FOR AMUSEMENT RIDES IN SINGAPORE

Version 1.0

Dated: 27 May 2011

Disclaimer

This guide is published by:

Amusement Rides Safety Department
Building Plan and Management Division
Building and Construction Authority.

Whilst every effort has been made to ensure the accuracy of the information contained in this publication, the Building and Construction Authority, its employees or agents shall not be responsible for any mistake or inaccuracy that may be contained herein and all such liability and responsibility is expressly disclaimed by these said parties.

Compliance with this guide does not mean that it supersedes the provisions of the Act and Regulations. The provisions of the Act and Regulations will take precedence over the guide where any difference exists.

Contents

1. Introduction

1.1 Purpose

This annual inspection guide is issued by the Commissioner of Amusement Rides Safety (Commissioner) to provide guidance on the requirements for the annual inspections of amusement rides in Singapore.

During inspection, enforcement officers from the office of the Commissioner may inspect and verify that the amusement rides comply with the Amusement Rides Safety Act (the "Act") and Regulations (the "Regulations") and the good practices highlighted in this guide.

The purpose of the annual inspection is for the Qualified Person to thoroughly check, verify and certify at least once every 12 months on the fitness and safety of an amusement ride for continued use for the period specified in the QP's certification.

1.2 Responsible Parties in these Guidelines

1.2.1 Operating Permit Holder

The operating permit holder is someone who holds an operating permit issued by the Commissioner under section 14 of the Amusement Rides Safety Act.

1.2.2 Ride Manager (RM)

The ride manager, appointed by the operating permit holder, shall oversee, manage and supervise the daily routine operation and maintenance of the amusement ride.

1.2.3 Qualified Person (QP)

A qualified person (QP), engaged by the operating permit holder, shall be a registered Specialist Professional Engineer in the discipline of amusement ride engineering under the Professional Engineers Act (Cap. 253).

For major amusement rides, the QP is required to appoint and consider the opinion and advice of a Conformity Assessor (CA) for the purpose of:

(a) Reviewing and certifying the design and specifications and the proposed installation or modification method and programme of a major amusement ride; or

(b) Supervising any installation or modification works in respect of a major amusement ride;

(c) Inspecting and certifying any major amusement ride, including the annual inspection; or

(d) Carrying out any other function under this Act in respect of a major amusement ride.

1.2.4 Conformity Assessor (CA)

A conformity assessor (CA), engaged by the Qualified Person (QP), shall assist the QP in carrying out the procedures (including inspection, test and certification of amusement rides) for determining whether the design and specifications, the proposed installation or major modification method and programme relating to a major amusement ride conform to applicable standard or requirement prescribed under the Act or Regulations.

1.3 Scope of Work

There are five main functions within the typical annual inspection of an amusement ride:

a) Preparation for Inspection

b) Physical Inspection

c) System Checks

d) Functional test

e) Documentation and Certification

These five main functions will be covered in detail in the following sections.

2. General Principles

The annual inspection is an independent check on the safety-critical components of an amusement ride to confirm that it has not deteriorated to an extent liable to cause danger.

This inspection should be carried out at least once every 12 months, throughout the operational life of the amusement ride. Sufficient time should be allocated for the annual inspection prior to the application for the renewal of the current operating permit. The application, together with the complete documentation and certification, should reach the Commissioner at least two weeks to one month before the expiry of the Current Operating Permit, depending on the complexity of the ride.

All areas of work covered in this inspection guide should form the basic scope of work in the inspection contract. The inspection reports and certification may be rejected if the inspection is incomplete due to the limited scope of work specified in the inspection contract.

When necessary, the QP may request for additional relevant inspections or testing to be performed, where these additional inspections or tests are required for the QP to certify the safety of the amusement ride.

The QP and CA who are appointed to carry out the inspection should be independent of the permit holder and not have any professional or financial interest in the amusement ride. They should not be engaged in any activities that may conflict with their independence of judgement and integrity in relation to their inspection activities.

The QPs and CAs should not work outside their area of competence, and therefore only qualified and competent QPs and CAs should be appointed, subject to the acceptance by the Commissioner.

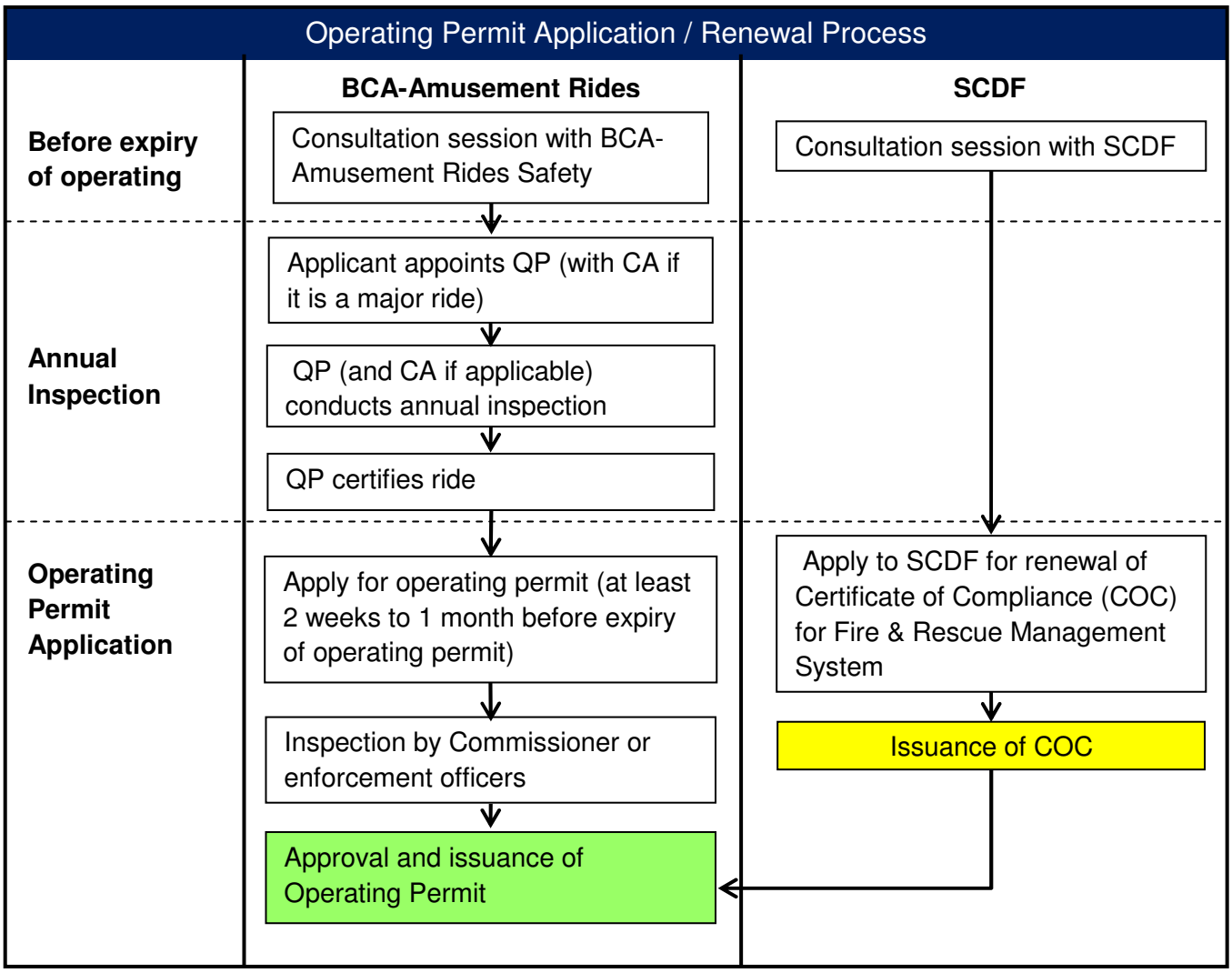
The annual inspection should cover (but not limited to) the following areas to ensure thoroughness:

- Structural elements, including those falling within the meaning of “building” as defined in section 2(1) of the Building Control Act (Cap. 29)
- Non-destructive testing (NDT)
- Electrical systems
- Mechanical components
- Hydraulic and pneumatic components

- Safety features such as safety interlocks and emergency stopping devices
- Other specialist areas relevant to the amusement ride
- Currency of risk assessment of individual ride
- Functional tests such as testing of control system, operating speed and range, safety devices, restraints and restraint systems, braking system and acceleration and deceleration

3. Procedures

3.1 Sequence of Application



3.2 Copy of Previous Annual Inspection Reports

A copy of the previous annual inspection report should be made available by the operating permit holder to the QP for reference. Items highlighted in the previous report shall be addressed in the current inspection. For example, if the previous inspection highlighted initiation of corrosion at some parts of the ride, the QP shall incorporate in the current inspection how this item shall be addressed.

3.3 Pre-Consultation Prior to Inspection and Submission

It is recommended that the responsible parties consult BCA and other relevant technical authorities such as SCDF, on the submission and inspection requirements prior to the commencement of the inspection work. This will help to ensure that the renewal of the operating permit is not delayed due to incomplete submissions or non-compliance with regulatory requirements.

4. Preparation for Inspection

The annual inspection should cover (but not limited to) the areas specified in Section 2 of this guide. During site inspection, QP should check on actual conditions such as:

- Quality of weldments
- Efficiency of joints
- Corrosion
- Weathering (example, for wire ropes and nylon components)

Before the commencement of any inspection, the following factor should be taken into account:

- Ambient conditions such as lighting condition, temperature, noise and adverse weather may affect the progress and outcome of the inspection. Additional equipment may be required to carry out the inspection in consideration of these factors.

4.1 Dismantling of Devices

All assemblies that may hinder the proper inspection of safety-critical areas specified in the manufacturer's manual or design review report should be dismantled to allow access to these safety-critical areas. Difficulty of access is not a valid reason for failing to inspect safety-critical components.

It is recommended that QP decides upon the parts to check based on desktop study and documentation review and informing the ride manager in advance.

The schedule specifying the required non-destructive testing (NDT) will also provide information on any disassembly required.

4.2 Identification of Critical Welds, Joints and NDT points

Critical welds, joints and non-destructive testing (NDT) points should be identified prior to the inspection, using the manufacturer's manual as a guide. The QP should also review other areas for critical welds, joints and non-destructive testing (NDT) points not specified in the manufacturer's manual, as the actual conditions may differ from the theoretical assumptions used in the manufacturer's manual.

4.3 Stripping of Paints or Coverings

The presence of paint or other finishes may adversely affect the detection of flaws or faults. Thus paints or other finishes or coverings may need to be removed prior to inspection of safety-critical areas, where deemed necessary.

4.4 Provision of Access and other Equipment

Adequate and safe access is necessary for the inspection. If additional access equipment is required, it should be provided by the permit holder or the QP, whoever is deemed more equipped and based on contractual agreement. The equipment required will vary, but may include:

- Access equipment such as ladders, boomlifts or scaffolds
- Lighting
- Visual aids
- NDT equipment
- Local cleaning equipment
- Measuring equipment
- Camera
- Personal protective equipment

4.5 Servicing or Replacement of Parts

The service history of the amusement ride, which includes details on the servicing and replacement of parts should be reviewed prior to inspection. This information can be used to infer any trends in deterioration of the amusement ride, and hence help the QP in the Inspection planning.

5. Physical Inspection and Testing

The purpose of the annual inspection is to determine whether any of the safety-critical components of an amusement ride have deteriorated to an extent liable to cause danger (e.g. by corrosion, wear, fatigue or crack). Particular attention needs to be paid to those components which have been highlighted in the manufacturer's manual and design review report.

Inspections and testing may require, but not limited to, the following components:

- Foundation and structural elements
- Wire ropes, chains and their accessories
- Pressure vessels and accessories
- Welds and joints
- Patron restraints
- Patron containment and clearance envelope
- Electrical components
- Control system
- Mechanical components
- Safety equipment
- Miscellaneous (guards, barriers, fencing and etc)

Any inspection requiring special techniques should have the procedures documented, e.g. instruction on how to perform tests such as over-speed, over-travel, block system tests etc. If such information is not available for some reason, the QP responsible for the tests should produce the test protocols, which must then be reflected in the annual inspection report.

5.1 Foundation and Structural Elements

The inspection for the structural supports and foundations (which directly support the ride and are NOT part of the building that houses the ride) must be done by a civil or structural Professional Engineer (PE) who then submits his report to the QP.

Foundations and its surrounding soil condition need to be inspected for any sign of soil settlement, fatigue cracking and serious corrosion.

The structural elements of the amusement ride, especially the load-bearing components (inclusive of tracks) and supporting structure, should be visually assessed for any sign of corrosion, wear, loosening of connection, cracking, bending, signs of mis-alignment and other structural defects.

If there are no signs of any structural deterioration or defects, the visual inspection should suffice and no further action needs to be taken, unless the structural PE otherwise advises.

If signs of significant structural deterioration or defects are present, the structural PE should make a professional assessment of the deterioration or defect and recommend appropriate actions to be taken. Such actions may involve repair works or full structural investigation to parts or whole of the amusement ride.

For relocatable rides, footings of rides should be checked for their stability. Rides and related items that are required to be level must be properly blocked and level be maintained. The blocks must have sufficient area to distribute the maximum load imposed so as not to exceed the soil bearing capacity of the ground it was located at or to cause excessive settlement.

Wood or steel mat are common material used for blocking. Concrete, brick or hollow blocks are not acceptable blocking. Blocking must be wider than the ride's mud sill or landing gear, wider than its height, and in good condition.

5.2 Wire Ropes, Chains and their Accessories

Inspection on wire ropes and chains should cover the entire length and includes any accessories fitted to it.

Wire ropes should be checked for lubrication, wear, wire breaks, deformations, corrosion, unbalanced or twisted block, kinks, jumped sheaves, points of terminations at both ends, etc. The end terminations should be checked for any signs of slippage and corrosion.

Inspection should also include wire rope drum, rope clamps and fittings. The grooves of the drum and sheaves should be checked for wear and bearing failure. The sheaves should be checked for cracks, wobble and noise.

Chains should be checked for lubrication, wear, deformations, cracks and corrosion.

Wire rope pulleys, chain wheels or sprocket wheels should be provided with guards to prevent the ropes or chains from jumping out of the grooves or teeth.

The capacity of the wire rope or chain replacement, and related accessories such as terminations, adapters, or clips should be verifiable either by certificates, manufacturer's markings, or testing.

Repair of the wire ropes, chains and their accessories should generally be avoided.

5.3 Pressure Vessels and Accessories

Certain classes of pressure vessels (such as those used to store compressed air, refrigeration fluid or steam) must be registered with the Ministry of Manpower (MOM). Typical pressure vessels found in an amusement ride are air receivers. These air receivers must be inspected by Approved Examiners periodically, and permit holder needs to ensure that the certificate of inspection for the air receivers remains valid for the period of the operating permit.

5.4 Welds and Joints

NDT is commonly adopted for welding checks to ensure structural integrity and prevent catastrophic failure. NDT should be carried out only by qualified NDT practitioner and according to manufacturer's specifications. Common NDT techniques include Dye Penetrant (DP), Magnetic Particle Inspection (MPI), Eddy Current, Ultrasonic Testing (UT) and Radiographic Testing (RT).

The QP should focus on the critical welds and joints identified in the manufacturer's manual and design review report. Where this is not specified in the manual, the QP must exercise his professional judgment to decide which welds are critical and propose for NDT checks, if deemed necessary.

Particular attention should always be given to location where there are changes in section geometry, load bearing welded connections, welded reinforcements and stress concentration areas.

QP shall ensure that the size, length and location of all welds conform to the requirements of the applicable welding code and to the detailed drawings of the designer.

Visual inspection for cracks in welds and base metal and other discontinuities should be aided by a sufficient light, magnifiers, or such other devices as may be found helpful.

5.5 Patron Restraints

The integrity of the patron restraint should be checked to make sure that it is in good condition, properly adjustable and functioning correctly. A sample strip down inspection of patron restraints on safety-critical components should be conducted unless this is not recommended in the manufacturer's manual.

All safety critical interlocks relating to seat restraint systems should be individually checked, both visually and by functional test, to determine that they are working correctly.

Check that all components of the patron restraint system including seats, bars, belts, harnesses, handholds, footrests, locks, catches, hinges and attachment points are properly maintained and correctly adjusted so they will be secured.

The adequacy of the restraint system should be checked in consideration of risk profile associated with the ride.

5.6 Patron Containment and Clearance Envelope

The patron-containment system should be carefully inspected. If there were to be any alteration, this would require a separate review of design to be carried out by a QP (+ CA if it's a major ride).

The adequacy of the patron-containment system and clearance envelope should be visually checked. The presence of overhanging items (e.g. theming items) should be taken into consideration when checking the patron clearance envelope. Parts of amusement rides that patrons may reasonably be expected to come into contact with should be smooth (e.g. free from unprotected protruding studs, bolts, screws, sharp edges/corners and rough/splintered surfaces). Wheels and bearings should be checked for corrosion, cracks, wear and general condition.

Where interlocks are fitted at the doors of amusement ride, the interlocks must be individually checked and tested.

Any systems used to support and contain the patrons should be securely fixed to the structure of the ride. These systems should have adequate strength for the intended forces produced by the ride and the reasonably foreseeable actions of the patrons. Any deterioration that reduces the strength of the fixture must be identified and rectified.

5.7 Electrical Components

The guidelines below do not supersede any requirement stipulated in national codes relating to electrical safety. The guidelines are provided to reinforce these codes, or to supplement the codes.

The integrity of the electrical installation should be checked. Any work carried out on electrical parts of amusement rides should be supervised by Licensed Electrical Workers (LEWs), i.e. licensed by Energy Market Authority (EMA).

The electrical system should be checked for any sign of deterioration since the last annual inspection and the significance of deterioration, if any, should be assessed. The results should be recorded in the ride log book.

The assessment should be carried out by taking the following steps:

- Ascertaining history and determining if any changes or modifications have been made.
- Visual inspection.
- Measurement and test.
- Functional test.

Where the amusement ride is powered from generators as a primary source (for example in the case of relocatable ride) or as a back-up source for permanent ride, the examination should also include the supply system and cabling of the generator set. The generator should not be accessible to unauthorised persons.

Where supplies are derived from a permanent source (e.g. substations or switch rooms) and access to these areas may not be permitted, the inspection will be limited to the amusement ride itself and the terminating apparatus of the supply cables.

It should be noted that for rides with electrically powered animatronics and theming, these areas should be included in the electrical inspection regime.

A thorough visual inspection should be made of all electrical equipment which is not concealed, with regard to the following:

- Corrosion.
- Damage.
- Excessive loading (overloading) such as signs of overheating.
- Wear and tear due to age.

- External influences such as weather and vibration

A full visual assessment should be carried out without dismantling equipment unless signs of deterioration are noticed. All the following items may be subjected to random sampling according to their assessed risks.

a) Lockable isolating devices

b) Slip rings, live rails, busbars and pick-ups

c) Socket outlets

d) Cables and electrical components

The point of supply / isolation area should have safe access and adequate lighting, and well maintained.

The cable connections should be examined where they are not enclosed to ensure that there are no bare conductors or terminals that are likely to cause electrocution or leakage.

Check that all lighting assemblies, fittings (particularly plugs and sockets) and other connections are suitable for the environmental conditions in the area in which they are situated. For example, if there is likelihood that electrical components to come into contact with water in a water based ride, then adequate protection must be in place to prevent this from happening.

5.7.1 Electrical Cables and Connections

Cables should be visually assessed to ensure that they are in good condition, with no hazardous damage to the insulation, and correctly secured where necessary.

Connecting devices such as plugs and sockets should be checked to ensure that they are suitably rated, not damaged and are complete.

The overcurrent protection devices (fuses and / or circuit breakers) are correctly selected for the current carrying capacity of the cables.

Check that cables which are moved regularly or flexed due to the motion of the amusement ride:

- Are in good condition.

- Are flexible, with a tough outer sheathing, or are in suitable flexible conduit that is in good condition, with correctly fitted glands where necessary.

- Are suitably routed and restrained to prevent strain on the terminations where they enter or leave any panel or enclosure.

Visually check that cables or wires are not being subjected to chafing where they pass through holes in enclosures, etc. Where necessary, grommets or other means of protecting the cables should be used.

5.7.2 Earthing and Bonding

The integrity of the earthing and bonding arrangements, when this is required, should be checked by inspection and testing.

The main incoming earth terminal (and/or electrode) should be checked visually for good condition and the value of the external earth loop impedance measured using a loop impedance tester.

All exposed metallic parts of current carrying electrical equipment should be connected to the main earth terminal. A sample of these connections will need to be confirmed by testing.

If visual assessment and sample tests demonstrate that any exposed conductive parts of the amusement ride are not satisfactorily earthed then testing should take place.

Where slip rings are used to transmit power, an earth slip ring should be provided and used. Bearings are not suitable for providing connections to earth.

5.7.3 Emergency Lighting

Emergency lighting should be illuminated and visually checked to confirm that there is generally adequate lighting to escape the amusement ride safely, should there be an emergency and loss of normal lighting.

The switching of emergency light fittings should be tested to confirm that they illuminate on loss of supply to the normal lighting that would be used, in that particular area, during an emergency.

It should be confirmed that emergency lighting can remain illuminated at a sufficient level to allow the area to be safely evacuated.

5.8 Control System

The control system components should be inspected to ascertain that:

- Their condition has not deteriorated to such an extent that they would operate incorrectly;
- Any settings are as specified;
- They are operating correctly, e.g. E-stop and proximity sensors.
- No unauthorised or temporary links have been used;
- Connections are not loose;
- Where there are replacement of component parts, that they are of the correct specification;
- Monitoring equipment, if any, is functional, e.g. CCTV.

5.9 Mechanical Components

5.9.1 Hydraulic & Pneumatic Systems

General

The list of safety critical hydraulic and pneumatic system should include, but is not limited to, the following:

- Accumulators.
- Elements of the patron restraint system.
- Braking systems.
- Drive motors, particularly those with brakes incorporated.
- Launch systems.
- Theming that is actuated by hydraulic or pneumatic systems.
- Control gates.
- Lifting and lowering (lifting cylinders, bellows, etc., and associated valves).
- Hoses and pipelines.
- Any other component that
  - may present a danger to the system under failure conditions, or
  - may present a danger during the process of failure, e.g. whipping of hoses, spraying of fluid, etc.

Any safety critical components that have been removed for testing or replaced since the last annual inspection should be identified and listed for inspection. An inspection should be conducted on such items to confirm that they have been installed correctly.

The schematic drawing for the system should be checked to confirm that it correctly represents the system to be inspected.

During inspection, a strip down of the components is recommended if the access to these components is restricted.

The following checks and tests should form part of the inspection where relevant:

- Filters should be checked for condition and suitability (i.e.to manufacturers' specification). Where replacement interval is specified by manufacturer, then this should be adhered to.
- Check for leaks.
- Listening for unusual noises during operation of the machine.
- Checking the correct installation of any components after servicing or replacement.
- Inspection of pipes, hoses and fittings.
- A check that valves and ancillary equipment are securely mounted.
- Filtration systems.
- Gauges where fitted.

The amusement ride should be observed operating in all available modes to ensure correct operation of the pneumatic or hydraulic systems.

Monitor the performance of actuators and ensure that they are working correctly. Check that cylinders and other components are moving at the correct speed and generating the correct forces. Where interlocks are provided these should be tested for correct function.

Pipes, hoses and fittings should be checked for detrimental foreign matter such as scale, burrs, swarf, etc, that may restrict flow or be dislodged and cause malfunction of and/or damage to any component including seals and packings.

Piping, both rigid and flexible, should be located to protect against foreseeable damage and not restrict access for adjustment, repairs, replacement of components or work in process. Pipe supports should not damage the pipe. Piping should not be used to support components where they would impose undue loads on the piping. Undue loads may arise from component mass, shock, vibration and surge pressure.

Flexible hoses should have the minimum length necessary to avoid sharp flexing and straining of the hose during the component operation. Flexible hoses should not be bent with a radius smaller than the manufacturer's recommended minimum bending radius. There should be minimal torsional deflection of the hoses during usage. Hoses should be located or protected to minimise abrasive rubbing of the hose cover. Hoses should be supported, if the weight of the hose assembly could cause undue strain.

Hydraulic Systems

The objective of a hydraulic system may be to extend and retract a hydraulic cylinder or actuator, or lock a cylinder in one place, e.g. in restraint systems or to drive a hydraulic motor to carry out a useful and sometimes safety related task, such as emergency pump for a hydraulic drive.

Equipment used for the erection and dismantling of amusement rides should be included, as these systems often form part of the main hydraulic circuit.

Having established the safety critical systems and safety critical components, the following actions are required before inspection of the ride:

- Check that where required, there is oil sampling analysis on the system carried out by accredited laboratory, as part of condition monitoring strategy for the system, and determine that it meets the oil quality standard set for the machine.

- Check whether the oil needed to be replenished or replaced since the last inspection.

The following checks can now be carried out on the ride:

- Look for leaks and check oil levels.

- Inspect hydraulic motors and pumps to ensure they are not loose or their integrity reduced in any way. All drive belts should be correctly aligned and tensioned. All drive shafts and couplings should be suitably guarded. Check the hydraulic motors and pumps for signs of vibration, excessive noise, alignment and leakage.

- Operate the amusement ride and time each safety critical hydraulic function. Record the times, pressures and the ambient temperature. Compare these with previous records and manufacturer's specification, if any.

- Where hydraulic interlocks are provided it should be checked that they function correctly.

- Where an over-pressure test is prescribed by the manufacturer, then this should be conducted.

Pneumatic Systems

Examples of components that should be inspected in a pneumatic system, but not limited to, are:

- Compressors / cylinders / receivers.
- Piping valves and gaskets.
- Safety devices and pressure relief valves
- Cylinders and actuators.
- Air dryers.
- Tank drains.
- Lubrication systems.

Compressors and pumps should be inspected to confirm that they are in good physical condition. All drive belts should be correctly aligned, tensioned and adequately guarded.

Inspection on valves such as pressure relief valves, pressure and flow control valves, non-return valves should be carried out with valves stripped down where possible. Critical components of valves such as valve seats, valve discs, valve stems, springs and the overall integrity of valves should be visually checked for any wear.

A running test should be conducted, and the system should be checked for any signs of vibration, excessive noise and leakage of compressed air. The blow pressure of the safety valves should be set to the required pressure which should not exceed the safe working pressure.

Where an over-pressure test is specified, then due care must be taken to ensure safety of persons involved in such test. Reference must be made to pressure vessels standards such as ASME Codes for the conduct of such test.

5.9.2 Mechanical Transmission Systems

5.9.2.1 Drives

Equipment providing motive power should be checked for proper attachment, cracks, corrosion, wear, alignment, sharp edges and mechanical damage. Power screw

drives, and rack and pinion drives, associated with lifting or elevating patrons should be visually inspected.

Power screw drives should be checked for proper lubrication, and if there is any sign of potential separation of the lifting carriage from the mechanism during normal use. Checks should also be made on wear of load bearing nuts, and the presence of locking devices to prevent the nuts from loosening.

Rack and pinion drives should be checked for proper lubrication and correct meshing of rack and pinion. The pinion should always be engaged with the rack with at least 2/3 of the tooth width and 1/3 of the tooth depth. Racks should be checked at both ends to confirm that there are mechanisms to prevent the pinion from travelling beyond its designed maximum limits of travel at either end of the rack.

There should not be excessive lubrication which could affect the proper functioning of gearing mechanism. Excess lubrication may also seep out and foul other components. Checks should be made to ensure that there are no physical damages such as excessive wearing, cracks and broken teeth

The physical condition of drive motors should be checked for corrosion, wear, deterioration, etc.

The condition of tyres and its pressure should be checked for compliance to manufacturer's specifications.

5.9.2.2 Brakes

Types of brakes to be inspected for amusement rides include longitudinal friction brakes, disc or drum brakes, motor end brakes, service brakes, emergency brakes, parking brakes, and back stops. Brake components such as brake linings, brake pads and disc should be inspected for cracks, corrosion, excessive wear, loose attachment, alignment, mechanical damage and correct functionality.

If the failure of the braking devices results in an unsafe condition, then the braking devices should be of fail-safe design.

5.9.2.3 Damping and Absorbers

The physical condition of damping systems and shock absorbers should be checked for any visible wear and tear, in particular, for signs of corrosion, correct attachment, cracks, alignment, mechanical damage and correct functionality.

5.10 Safety Equipment

Safety equipment which is not designed to function during the normal operation of the ride should be checked. Examples of these are:

- anti-roll back system, emergency brakes or other systems providing redundancy and back-up systems;

- chains, ropes and other redundancies used to retain parts of the ride in place in the event of structural failure;

5.11 Miscellaneous

5.11.1 Guards, Barriers and Fencing

The condition of guards, barriers and fencing should be sturdy and capable of preventing patrons from falling off. These should be checked for any sign of cracks, bending, loosening and wear, and that all locking devices and securing pins are in place and in good condition. They should be designed, constructed and erected to inhibit overturning by spectators or patrons.

Where available, guards, barriers and fencing should be erected based on manufacturer's specifications.

5.11.2 Platforms, Ramps, Floors, Stairs and Walkways

All surface areas of platforms, walkways, ramps and stairs accessible to the public should be checked to be slip-resistant even when wet. They shall be free from tripping hazards, and there should not be nip or pinch points in areas open to the public. Any change in elevation of platform levels should be clearly marked in order to avoid tripping.

5.11.3 Signage

Rules of ride and other safety signages should be checked to make sure it is in good condition, clearly legible and visible.

6. System Checks

System checks consist of an audit of the system put in place to ensure the ride has been operated safely and maintained properly. Typically this is done by checking the log books of the ride, maintenance records, memorandums of change, work orders and other documentary evidence. There should also be checks made on training records of operators to ensure that a proper training programme is in place.

An audit of the adverse incident reports should also be made as this provides vital evidence of the repairs the ride has undergone, and the need to check potential areas of failure.

The QP should have access to the required information and make all reasonable enquiries with the ride manager of the amusement ride when conducting system checks.

The QP should also check the risk assessment of the ride, to ensure that this has been reviewed periodically, and the measures enumerated by the assessment are implemented.

6.1 Original Reports

The original reports of design review and specifications, risk assessment and commissioning tests should be available. The reports from previous inspections should also be scrutinised to help the QP plan for his inspection.

6.2 Operation Manual

The operation manual consists of operation instructions for daily operations and operator-level maintenance instructions. The QP should check that the operation manual is updated, especially if there is any modification made to the amusement ride or any changes in operation procedures.

6.3 Maintenance Manual

The maintenance manual consists of maintenance instructions for any maintenance that is higher than the operator-level maintenance. This can be scheduled maintenance tasks to be done weekly or monthly. The QP should check that the maintenance manual is updated, especially if there is any modification made to the

amusement ride or any changes in maintenance requirements. The QP should also make reference to the maintenance records.

6.4 Maintenance Records

Service history of the amusement ride should be kept in the maintenance records. The QP may use the service history and identify any trends in deterioration of the amusement ride to determine how these would influence the way in which the inspection is to be carried out.

Past records and reports of repairs and minor modifications, and whether any of the modifications are safety-critical, and may affect the safe operation of the ride, should be detailed here.

After a repair / minor modification, the amusement ride should not be operated until details of the repair / minor modification and any relevant tests and inspections are recorded in the maintenance record, and that the relevant manuals and documents are updated.

QP should check that the maintenance records are updated.

6.5 Inspection Requirements

This would include the manufacturer's stated inspection requirements (examination and testing) for the amusement ride. Functional tests and the expected and/or reported results should also be included here.

Where appropriate, reference material relating to the original condition of the ride should be included, e.g. the results of original NDT or measurements of the performance of safety-critical components or systems. This can be used for comparison with current reading, to give an indication of the level of wear that has taken place.

If there were any previous changes in the inspection requirements, such as the schedule for NDT testing, these should also be included.

6.6 Log Book

The log book should file all the information, data and records related to the ride. The information should consist, but not limited to, the following:

(a) Past records and reports of major modifications, and whether any of the modifications are safety-critical, and may affect the safe operation of the ride.

(b) Design review and specifications, risk assessment, commissioning tests of any major modifications.

(c) Past annual inspection reports and certificates.

(d) Relevant inspection reports that include information on the examination and testing of the amusement ride.

(e) Accident history - The QP should check that any relevant information on incidents, accidents or dangerous occurrences for the amusement ride is included, and whether they have any safety implications.

(f) Safety bulletins from manufacturer, the trade associations, etc.

(g) Recommendations from previous inspections.

QP should check that the log book records are updated.

6.7 Incomplete or Invalid Information

If any of the required reports or records is missing, incomplete or invalid, the QP should inform the operating permit holder for the ride, and that the inspection cannot be completed.

An incomplete inspection will not be accepted by the Commissioner for the purposes of issuance of operating permit.

7. Functional Tests

Functional tests are carried out to demonstrate that, at the time and place of the test, the amusement ride is performing to the design specification and is safe for operation.

In particular, the tests will seek to confirm the following:

- Correct working of control systems
- Correct operating speeds and range
- Correct operation of safety devices (e.g. anti-rollback systems, emergency stop system and blocking system)
- Correct operation of restraints and restraint systems
- Efficiency of the braking system
- Acceleration and deceleration under normal working conditions and in cases of emergency

The functional test should not be attempted until all works on safety-critical components, identified as necessary as a result of the inspection, have been completed.

The amusement ride should be observed operating (with representative loads if necessary) and the effective operation of safety-related controls checked. The load may be provided by patrons if safe to do so.

The observations made should be compared with the operating specifications set out in the operations manual. This includes those for speed controls, stopping devices and any interlocks, for example between patron restraints and the starting device.

For special tests such as over-speed, over-travel and etc, the QP should refer to the operations manual to check for any requirement for such tests.

8. Documentation and Certification

Upon completion of the inspection, the QP(s) involved should prepare a written Annual Inspection Report for submission together with the permit holder's application for renewal of operating permit.

8.1 Annual Inspection Report

The Annual Inspection Report should follow the following format and cover the following areas:

(a) Report number

(b) Inspection period and completion date

(c) Expiry date of validity of the inspection – This should be at most 1 year from date of completion of inspection

(d) Extent, scope and areas of inspection

(e) Preparation for inspection

(f) Method of inspection

(g) Results of system checks (e.g. identify change and modifications)

(h) Functional tests conducted

(i) Limitations to the inspection (e.g. poor / limited access)

(j) Results of the inspection – This should include lists of any faults or any areas which require further inspection or testing. Annual inspection report should consist of the following areas:

- Structural
- NDT
- Electrical
- Mechanical
- Hydraulic
- Pneumatic
- Other specialist areas relevant to the amusement ride

- Safety and risk assessments
- Functional test

(k) Recommendations – The QP should clearly state one of the following recommendations:

i. There is no non-compliance found. The amusement ride complies with the requirements and is safe for operations for the next 12 months.

ii. Non-compliances were found and the QP recommended the corresponding remedial actions (list the non-compliance and remedial actions recommended).

The remedial actions have subsequently been carried out as recommended. QP has re-inspected the amusement ride and there is no more non-compliance found in the re-inspection.

The amusement ride now complies with requirements and is safe for operations for the next 12 months.

(l) Any other relevant information, especially pertaining to the safety of the amusement ride.

(m) Attachments (to list)

8.2 Reporting of Serious Safety-Related Defect

On detection of a serious defect, which may present a danger to the public or the operators, the QP should inform operating permit holder for the amusement ride in a written report. The report should include the defect, any immediate instructions (such as not to use the amusement ride until the defect has been rectified and re-inspected), and whether the defect has any implications for other similar amusement rides.

Where such defect is detected, the QP must also immediately inform the Commissioner.

8.3 Remedial Actions

If actions need to be taken before the amusement ride can be used again, or within a specified time, the QP should inform the operating permit holder for the amusement ride accordingly. The operating permit holder should then carry out the required remedial actions, after which the QP should re-inspect the amusement ride before

certifying that the amusement ride complies with the design specifications and safety requirements.

The details should be included in the Annual Inspection Report.

8.4 Certification

Upon completion of the inspection, the QP should certify that the amusement ride complies with design specifications and safety requirements within a specified period of time. This certificate should be submitted to the Commissioner during the application for renewal of operating permit.

Annex A - Checklist of Annual Inspection Guide

Ride Name: _____ Date: _____ to _____

Amusement Ride No.: _____ Location: _____

No.	Section in Guide	Points of Inspection	S=Satisfactory, U=Unsatisfactory	Remarks, if any
		Foundation and Structural Elements		
1	5.1	Foundation and its surrounding soil condition		
2	5.1	Structural elements (inclusive of tracks)		
3	5.1	Footings (for relocatable rides only)		
4	5.1	Check that ride is level (for relocatable rides only)		
		Wire Ropes, Chains and their Accessories		
5	5.2	Condition of wire ropes and accessories		
6	5.2	Condition of chains and accessories		
		Pressure Vessels and Accessories		
7	5.3	Condition of pressure vessels		
8	5.3	Condition of air compressor		
		Welds and Joints		
9	5.4	Condition of welds		
10	5.4	NDT checks on welds, if any		
11	5.4	Condition of joints (inclusive of tightness check)		
		Patron Restraints		
12	5.5	Condition of patron restraints		
13	5.5	Safety interlocks of seat restraint systems		
		Patron Containment and Safety Envelope		
14	5.6	Condition of patron containment system		
15	5.6	Check on wheels and bearings		
16	5.6	Check on patron safety envelope		
		Electrical Components		
17	5.7	Integrity of electrical installation		
18	5.7.1	Condition of cables and connecting devices		
19	5.7.2	Integrity of earthing and bonding arrangements		
20	5.7.3	Condition of lighting		
21	5.7.3	Condition of emergency lighting		
		Control System		
22	5.8	Check on control system		
		Mechanical Components		
23	5.9.1	Condition of hydraulic system		
24	5.9.1	Condition of pneumatic system		
25	5.9.2.1	Condition of drives		
26	5.9.2.1	Conditon of drive tyres and its pressure		
27	5.9.2.2	Condition of brakes		
28	5.9.2.3	Condition of damping system and shock absorbers		
		Safety Equipment		
29	5.10	Condition of safety equipment (anti-roll back, E-stop, redundancy system)		
		Miscellaneous		
30	5.11.1	Condition of guards, barriers and fencing		
31	5.11.2	Condition of platforms, ramps, floors and walkways		
32	5.11.3	Signage		
		System Checks		
33	6	Check review of risk assessment is conducted and risk assessment up-to-date		
34	6.1	Original reports (design and specifications, risk assessment and commissioning tests)		
35	6.2	Check operation manual updates are available		
36	6.3	Adherence to maintenance manual		
37	6.4	Check on maintenance records		
38	6.5	Check on manufacturer's stated inspection requirements		
39	6.6	Check log book completeness		
		Functional Tests		
40	7	Conduct functional tests		

A) For your safety: "LOCK OUT / TAG OUT" ride before inspecting the ride.

B) This is a guide checklist. QPs are expected to develop their own checklist for individual rides.

C) This guide should be expanded to fill in the details for each item used.