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Inspection and Certification of Passenger-Carrying Rides
Inspection et autorisation d'exploitation des transports de personnes
Inspektion und Zulassung von Passagiere befördernden Bahnen

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SUMMARY

This paper describes and comments on the voluntary UK scheme for inspecting and certifying theme park and fairground rides, and makes particular reference to the public safety aspects related to structural safety of the rides themselves.

RÉSUMÉ

L'auteur décrit et commente le programme britannique non obligatoire sur l'inspection et l'autorisation d'exploitation de voies ferrées dans les foires et parcs d'attractions. Il attire l'attention sur les aspects de la sécurité publique qui est directement liée à la sécurité des structures porteuses des voies de transport elles-mêmes.

ZUSAMMENFASSUNG

Der Beitrag beschreibt und kommentiert das freiwillige britische Programm zur Inspektion und Zulassung von Bahnen in Vergnügungsparks und auf Rummelplätzen. Insbesondere wird auf die Aspekte der öffentlichen Sicherheit hingewiesen, die mit der Tragwerkssicherheit der Bahnen selbst verbunden sind.



1. INTRODUCTION

Recent estimates show that more than 500 million individual rides are enjoyed each year in the U.K. on the 10,000 or so passenger-carrying amusement devices that operate on theme parks, fairgrounds and travelling shows. Some large-throughput rides at fixed locations have annual usage some of the order of 1,500,000 persons per year. Typically, these rides will be used on a more-or-less continuous basis for a season of 1,500 hours spread over the period from late March to early November and thus have an average throughput of 1,000 persons per hour. Visitor numbers exceed 6.5 million per year at the largest U.K. site (Blackpool Pleasure Beach) where entry is free and a charge levied for each ride, and numbers exceed 2.25 million at the largest U.K. site where a single entrance fee is charged (Alton Towers).

Notwithstanding periodic media interest in accidents on rides, a study undertaken for The Health & Safety Executive in 1990¹ concluded that the risk of serious injury or death during an assumed typical visit ("session") by a member of the public was significantly safer than the risks of:

- Travelling to the fairground by car
- Cycling (for the same time as actually spent riding rides)
- Horse-riding (for the same time as the "session")

by a factor between 7 and 20 times safer. Somewhat surprisingly the analysis also shows that it was about twice as safe to spend a two-hour "session" at a fairground, riding 10 rides for a total of 20 minutes compared to 2 hours of "average existence" outside a fairground.

The causes of accidents that do occur on rides can be classified broadly into two classes: Structural and Operational. Structural causes include malfunction and physical failure of the ride itself and can be conveniently subdivided into structural, mechanical and electrical safety, the latter including, for certain major installations, instrumentation and control. Operational causes includes accidents caused by operator or attendant acts or omissions and also direct passenger or other visitor/public failure to observe safe behavioural practices. For the purposes of the remainder of this paper, it is intended to concentrate on the Structural aspects of ride safety (using the wide definition of Structural given above, i.e. including mechanical and electrical safety).

2. HISTORICAL REVIEW

Fairground rides are believed to have originated in Russia in the eighteenth century, when artificial ice-slides were constructed from timber structures and passengers rode the slopes on toboggans. Wheeled versions (also on wooden, but not "ice" slopes) were introduced into France and spread rapidly into a number of European countries.

The birth of modern fairground rides occurred in the last two decades of the nineteenth century in the U.S.A. which has since consistently led the world in more sophisticated and more thrilling ride developments. In the U.K. the influence of the U.S.A. has always been strong and fixed fairgrounds based on American rides and attractions were established here before 1900.

By the 1930's very major rollercoasters had been constructed in the U.K. (a number of which survive reasonably intact from that time) and in the 1960's



and a new breed of steel rollercoasters began to appear. In 1978, for example, Blackpool Pleasure Beach installed Europe's "first" looping coaster (the Revolution) which was made in America, and by the 1980's an explosion of new rides, new theme parks and revived interest in their enjoyment was due partly to increasingly easy access to the U.S.A. (particularly to Disneyworld in Florida) and partly to the success of "greenfield" U.K. locations like Alton Towers and Thorpe Park.

Although there have always been accidents on fairground rides since they were first introduced, public attention in the U.K. was particularly focused by the major roller-coaster accident at Battersea Fun Fair in 1972 when a mechanical failure led to the deaths of five children. Since then many of the more reputable owners/operators have made attempts to conduct independent inspections of their rides; operator/mechanical inspections had always been undertaken, but it is probably fair to say that they had been directly concerned with the requirement to operate the ride without malfunction or breakdown rather than explicitly for safety-related purposes.

In 1984 The Health and Safety Executive (HSE) introduced the "Code of Safe Practice at Fairs"² which provided a framework for annual independent inspections and certification of all passenger-carrying devices. It was, and remains to this day, a voluntary scheme, although the main trade bodies of theme parks and fairgrounds (BALPPA and The Showmans Guild) are understood to make compliance with the Code a condition of membership. In the case of BALPPA, this extends to an obligation to file annual copies of the Report of the Thorough Examination and Certificate (if issued) with BALPPA, which also maintains an index of unique ride identification numbers that are particularly useful when rides are bought and sold and details of their past history are being reviewed.

To provide further and more detailed technical information on the design, construction, modification, repair and maintenance of rides, a "Technical Annex" to the Code was published in 1988³. A revised version of the code itself, "Fairgrounds and Amusement Parks : A Code of Safe Practice" was published by HSE in 1992⁴. It is worth noting that both editions of the code and technical annex have been written with their active participation of the industry itself.

The new code (1992) includes a requirement for a Functional Test, on an annual basis, as part of the Thorough Examination. Previously, tests were only required every 4-years and understandably there was concern that some examiners may have issued certificates for rides which they had not observed in operational mode.

3. DESCRIPTION OF THE PRESENT U.K. SCHEME

Inspections, called "Thorough Examinations", are carried out on each ride, on an annual basis, by a "competent person". There is no specific requirement as to the qualifications of the competent person, although the code does require them to have appropriate "qualifications, knowledge, experience and supporting resources". The only specific requirements set down in the HSE code are that the person shall be at least 25 years old, and shall be independent of the operator/owner of the ride. Most ride examiners are members of a recently established body called (NAFLIC, National Association for Leisure Industry Certification) who are currently drawing up guidelines for the qualification levels considered appropriate for individual "competent



persons" but naturally these cannot be mandatory in the present regulatory framework.

Practice varies as regards the different aspects of the inspection, i.e. the structural, mechanical and electrical safety considerations. For small devices, typically non-electrical or simple motor-driven children's rides, one person frequently carries out all three items. However, some inspection organisations prefer to combine the structural and mechanical aspects (which are often very closely linked in any event), and then have all electrical inspections carried out separately, by a different person, who will issue a separate report and certificate. For very major rides, e.g. purpose designed rollercoasters, three separate persons with the necessary skills and expertise for each discipline may well be involved. Careful coordination of the physical inspections and the reports is required to ensure that the owner/operators interests are properly attended to.

Practice also varies as regards timing of the inspections. Almost all rides in the U.K. are operated on a seasonal basis for between 200 and 240 days (March/April to October/November) and the close season is obviously, for commercial reasons, when most inspection work is undertaken. Almost all rides require dismantling to some extent to allow inspection and then reassembling for the functional test run. Inspections are commonly done either soon after the season ends, when rides are stripped down and the inspection reports form a basis for any maintenance and repair/replacement work required; or alternatively towards the end of the close season when all the routine maintenance etc has been done by the owner/operator. Each of these approaches has both merit and disadvantages as follows:

Early inspection - gives the owner/operator notice of repairs/replacement in good time, but may encourage the use of the inspections as a guide for maintenance/repair and so lessen the responsibility of the owner/operator to establish and undertake this work to his own satisfaction. Also, if faults or defects are found, the inspector will need to make a return visit after repair works have been completed, but before reassembly, to re-inspect the ride in order to issue certification.

Late inspection - allows the owner/operator to present a ride after all maintenance/repair work has been completed, matching more closely the intention of the independent inspection requirements. However, if any defects or faults are discovered by the inspector, there may be severe pressures on time for the owner/operator to carry out work and have it re-inspected.

The issue of a certificate is not made using a fully standardised format, although Appendix 2 of the HSE code does specify key features of the content of the certificate. Of particular importance is to clarify whether the certificate covers only one or more of the categories, structural, mechanical and electrical and to precisely specify any work needed on the ride within specified time or usage limits (work needed before use of the ride would normally prevent issue of a certificate to use the ride, as re-inspection would be necessary).

During both structural and mechanical Thorough Examinations it is often necessary for NDT inspection techniques to be used on steel fabrications, which are susceptible to fatigue cracking from the repeated loadings



associated with dynamic ride motions. It is very important however, to use NDT as a tool of the appointed person carrying out the examination, and not to rely wholly on the technology of the NDT work itself. The Code of Safe Practice acknowledges this (clause 101) by placing an obligation on the appointed person to specify to an NDT operator where tests are to be undertaken.

4. THOROUGH EXAMINATION PROCEDURES

The use of the term "Thorough Examination" has been deliberate, so as to align the standard of work with the particular meaning of the term that has grown up by custom and practice in other safety-related industries such as pressure vessels and cranes.

At the core of the procedure is a careful and detailed visual examination to check for wear, signs of misuse or distress, misalignment, lack of fit or other defects. A clear understanding of how the ride operates is necessary in order to evaluate both the most likely locations for defects to occur, and the most critical components where defects or failure could have serious consequences.

Considerable guidance is available from experience on common rides (either identical production runs or similar variants) and aside from any individual examiners own expertise, two published sources of advice and information are as follows:

A series of Guidance Notes published by HSE.

A series of Technical Bulletins issued by NAFLIC for examiners.

Many rides have multiple identical components, for example, suspension arms on rotating "twister" type rides. Here a suitable strategy is normally to select a sample of these components for examination, maintaining a detailed record of which components were examined from one year to the next so that appropriate sampling coverage is provided.

Prior to the actual physical examination data needs to be collected on the available information from the manufacturer and operator. Of great importance is information relating to modification and repair work; operators appear to be very pragmatic in relation to undertaking such works and much practical work that in other industries would be carried out by specialist external contractors have traditionally been carried out in-house by the operators own workshops and staff. With some notable exceptions, the quality of records of such work has not matched the quality of the work itself, which causes problems in establishing exactly what has been changed or repaired.

An excellent written flowchart of examination procedure is provided in the Technical Annex which combines structural and mechanical inspection into one sequence, and then provides a separate sequence for electrical inspections.



5. CONCLUDING REMARKS

The U.K. voluntary scheme of ride inspections and certification has now been in operation for eight seasons and has been very widely taken up and accepted by operators and owners. Considerable maturity has been achieved with the active cooperation of the industry and the author is convinced that both overall standards and expectations of safety for the public in using passenger-carrying fairground rides has been enhanced.

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