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ASSESSMENT REPORT

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Apparatus: Plastic Elevator Buckets

Manufacturer: Tapco Inc.

Report No: R51A17242A
Commercially in Confidence

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ASSESSMENT REPORT

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1 INTRODUCTION

Carried out by SCS on behalf of:	Tapco Inc
Address:	225 Rock Industrial Park Drive, St Louis, Missouri. 63044. USA
Equipment:	0609B, 0609D, 0609NS Elevator Buckets
Assessment standards:	EN13463-1: 2001 CLC/TR 505: 2003
Assessments conducted between:	22/11/2207/ and 10/01/2008 Unless otherwise stated, all assessments are recorded in SCS Project Notebook number 51A17242 Rev3

The aim of the assessment was to determine compliance of the equipment with the Essential Health and Safety Requirements of the ATEX Directive 94/9/EC (Annex II).

This report draws extensively on the information provided in CLC/TR50404: 'Electrostatics – Code of Practice for the avoidance of hazards due to static electricity'. This document can be used to provide further information. This report can be used to assist in the assessment of plastic elevator buckets against the requirements of EN 13463-1: 'Non-electrical equipment for use in potentially explosive atmospheres'. Attention is focused on avoidance of static ignition hazards.

This report does not assess the prevention of ignitions where the powder being conveyed may have solvent vapour present in sufficient quantity to generate a hazardous zone for a vapour explosion, nor does it negate any requirements for a formal assessment of the end user system.

2 DESCRIPTION

The style CC-HD 9 x 6 inch elevator buckets considered in this assessment are available from Tapco in HDPE (High Density Polyethylene), Nylon and Urethane. The buckets are of an agricultural style and are used for lifting and handling granular bulk materials such as grains, peletised or extruded feeds, fertilisers, seeds, salt, sand, chemicals and food products.

The buckets are generally intended for attachment to Bucket Elevator Apparatus, generally classified as being either head-driven or boot-driven in their principal mode of operation. Each elevator category typically includes a vertically-oriented endless belt which co-operates both with an upper pulley and with a lower pulley, and to which are attached multiple, spaced-apart, material-carrying bucket elements. The elevator primary drive is operatively connected to the upper pulley in the case of head-driven bucket elevators and to the lower pulley in the case of boot-driven bucket elevators. A suitable housing with supply and discharge openings encloses the bucket elevator pulleys, endless belt, and attached material-carrying buckets.

3 ASSESSMENT

3.1 Production of static in powders

General
The term 'powder' means particles with sizes ranging from those of fine dust to granules or chips. The ignition sensitivity of a given product with respect to ignition by discharges due to static electricity is characterised by the minimum ignition energy.

The minimum ignition energy (MIE) depends strongly on the fineness of the powder; the lowest values relate to very fine powder.

Hazard assessment should therefore always be based on the minimum ignition energy of the finest particle size fraction which may be present in the processes. This fraction is usually obtained by sieving a sample through a 63 µm sieve. If the relevant minimum ignition energy is above 10 J and there are no flammable gases and vapours, special measures to minimise static electricity ignition hazards are usually not necessary. Precautions could be necessary to minimise electric shock risks.

Powders in the absence of flammable gases and vapours
It is assumed that the powder is handled and processed free from any flammable gases and vapours, i.e. the powder does not contain significant levels of flammable solvent and flammable gases or vapours are not present in the process nor could they be added from neighbouring processes.

To assist with the guidance, powders have been divided into 3 groups depending on their volume resistivity:

(a) Low resistivity powders, e.g. metals, with volume resistivities up to about 10 MΩ/m;
(b) Medium resistivity powders, e.g. many natural organic powders, with volume resistivities in the range 10 MΩ/m to 10 GΩ/m;
(c) High resistivity powders, e.g. polymers, some synthetic organic powders and very dry natural organic powders with resistivities of 10 GΩ/m and above.

In practice, low resistivity powders are rare. Even metal powders do not remain conductive for very long because oxide films form on the surface and increase their resistivity.

Charging of powders
Contact charging occurs extensively in powders. The charging characteristics are often determined at least as much by surface contamination of the particles as by the chemical composition of the powder itself and the amount of charge build is usually difficult to predict. Charging can be expected whenever a medium or non-conductive powder comes into contact with a dissimilar surface. It occurs, for example, during mixing, grinding, sieving, pouring, micronising and pneumatic transfer.

Charge retention
Charge will accumulate on and be retained by a powder if the charge generation rate exceeds the rate at which the charge dissipates.

3.2 Charging mechanisms

The following static charging mechanisms were considered:

- Contact charging between the powder and the bucket that will occur when the bucket dredges through, and fills with powder, or as the powder is emptied from the bucket.
- Contact charging between powder particles as the powder enters and is emptied from the bucket.

Both these charging mechanisms occur at the same time, and are therefore intermittent as no charging will occur between the filling and emptying points.

The following list gives a detailed assessment of the different types of discharges and an assessment of the risk of their occurrence when a bucket elevator is used with plastic buckets.

a) Spark discharges
Based on the information provided in CLC/TR50404 Annex A3.2, the greatest risk of an incendive discharge is from a conductive part that is insulated from earth and that can become charged to a high level. This is because static charge can be stored and discharged more easily in a conductive part than on a non-conductive surface. This would be a spark discharge and Section 3.4 of this report details the precautions that can be taken to minimise the risk that they will occur.

b) Brush discharges
Brush discharges can occur when earthed conducting objects approach highly charged non-conductive materials, as when the buckets move past metal supporting structures of an elevator. The present state of knowledge indicates that combustible powders with a Minimum Ignition Energy (MIE) of more than 3 mJ are unlikely to be ignited by brush discharges - reference CLC/TR 50404:2003 clause 7.2.4(b). This is reflected in the recommendations in Section 3.4.

c) Corona discharges
Corona discharge can ignite flammable gases and vapours but cannot ignite combustible powders – reference CLC/TR 50404:2003 clause 7.2.4(c).

d) Propagating brush discharges
Propagating brush discharges are associated with prolific charge generating mechanisms such as pneumatic transfer of powders (CLC/TR50404 Annex B1.4); the charging mechanisms described above were not considered to be prolific.

Very high levels of surface charge can be produced on a non-conductive sheet with an earthed metal backing. It was considered that the construction of the bucket and its assembly in a typical bucket elevator would not represent a risk because the bucket is made without a metal backing plate.

e) Cone discharges
This can occur when highly charged powder is loaded into a silo. As the powder is being conveyed by the buckets this situation was not considered applicable, but consideration should be given to the possibility of cone discharges in the upper bin, into which the powder is emptied.

3.3 Tests for charge dissipation

Section 4 of this report records the plastic elevator bucket materials do not have a surface resistance of less than 1 GΩ and therefore they cannot be considered dissipative within the requirements of EN 13463-1.

3.4 Avoidance of static discharges

It was assessed that the plastic elevator buckets could be utilised in equipment provided the following conditions are met:

- In the case of high resistivity powders reduce the speed (and therefore agitation) of the product flow. This will minimise static produced between particles. There will also be a longer relaxation time between static charging events and, whilst static generation may not be eliminated, it can be reduced and controlled (low speed transmission is defined in CLC/TR 50404:2003 clause 4.5.4 as 5 m/s)

- The belt should be manufactured from an anti-static material such that metal parts of the construction (e.g. the bolts affixing the bucket to the belt) have a suitably low impedance to earth. It is essential that layers of non-conductive adhesives used to connect the belt do not interrupt the conductive path.
- Avoid using the plastic buckets with materials that are particularly prone to generating static (e.g. polymeric powders). If the propensity of the material to generate static is not known it is recommended that specialist advice is sought.
- Use plastic buckets only with powders that have a minimum ignition energy of 3 mJ or greater.
- Ensure all metal parts have a low resistance path to earth. Particular care should be taken to ensure an effective earth leakage path for bucket fixings but all other parts, e.g. head and tail drums, should also be checked.
- Earthing checks should be stipulated in the user instructions as a requirement on installation and also to be conducted regularly whilst in service to verify continuing compliance.

4. Tests conducted

Test	Standard reference	Evaluation of result	Report #
Insulation resistance test of parts of enclosures of plastic materials.	EN 60079-0: 2006 clause 26.13	HDPE – Insulation Resistance >1GΩ Nylon – Insulation Resistance >1GΩ Urethane – Insulation Resistance >1GΩ All three materials are considered to be a potential source of ignition as they exceed the maximum allowable surface resistance limit. They doe not comply with the requirement for anti-static material.	07/0693

The report number in column 4 refers to the relevant Sira internal test report.

5. CONCLUSION

Tapco plastic buckets can be incorporated into bucket elevators for use in Category 1D application provided the precautions described in Section 3.4 of this report are used to minimise the risk of an incendive static discharge.