PS5/1

Measuring wheelchair reliability

Summary
Wheelchair reliability is an important consideration for wheelchair users and wheelchair services alike. Wheelchair reliability affects user safety, user satisfaction, maintenance costs and efficiency of a maintenance service. WestMARC have developed a means of quantifying wheelchair reliability. This presentation outlines the method and provides examples of applications.

Aims & Objectives

- To describe the method used to measure wheelchair reliability
- To present an analysis of the findings, including the identification of risk factors
- To describe applications of the findings
- To describe the limitations of the method

Background

It became apparent at WestMARC that there was no objective means of collating data relating to the reliability of the wheelchair after issue. It was identified that this information would be useful and would supplement the established laboratory testing outlined in ISO7176. WestMARC's wheelchair database of 44,000 active wheelchair users was used as a source of information.

Method

The technique was based on a literature review of the areas of reliability, engineering and risk management. Tools that are well established in these fields were assessed based on their suitability for the application. The method considers three factors of the wheelchair's reliability:

- the survival function of the wheelchair
- the rate of occurrence of failure of the wheelchair
- the severity of failure

The wheelchair's reliability was therefore a function of these factors and can be expressed as a financial value in GBP. The method was validated against an independent sample.

Results and Testing

The expected annual maintenance cost of 10 of the wheelchair models commonly provided by WestMARC was quantified (including powered, manual, paediatric and energy efficient wheelchairs). The reliability of commonly specified wheelchair models was compared.
User characteristics were identified that have significant impact on the wheelchair's reliability performance. User characteristics that did not have significant impact on the wheelchair's reliability performance were also identified.

Discussion

This method has applications in the areas of planned preventative maintenance, wheelchair refurbishment, inventory management, clinical provision, and cost-benefit analysis.
Most notably, we are applying this work in the development of a risk based planned preventative maintenance strategy.
Limitations of the method include susceptibility to errors introduced by data mining, and limitations of available data on the database.

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£3000 saving with battery testing
(Boring Batteries?)

Summary

Deep cycle batteries, commonly known as GEL, need to be reliable, particularly when used in powered wheelchairs by someone with a disability. It is imperative that the remaining life of the battery is known in order to reduce the amount of unexpected failures.

Within NHS wheelchair and special seating services, it is also important to ensure that, irrespective of a battery's age, it is not unnecessarily replaced simply because it appears outwardly to be past its best.

The amount of deep cycle batteries sent for disposal or recycling can amount to many thousands of pounds' worth in a very short period. Testing or checking these batteries accurately can often be time consuming, and sometimes requires repeating when irregularities arise. A more efficient, accurate, reliable and repeatable method, with quality record keeping, was therefore needed.

Dorset NHS wheelchair service undertook a rapid, combined trial and study exercise during normal working practice, so as to eliminate/minimise any disruption to service provision.

The result of this trial and study saved £3000 in just 4 weeks.

Aims & Objectives

The need to test batteries became apparent in late April/early May 2014, when the amount being placed for disposal/recycling was of great concern. At this same time, it was noted that some appeared to be relatively new, as well as some being old.

With the cooperation of the repairs engineers team, an investigation of sorts started.

The rehab engineers and the repairs team worked together with their current skills and general knowledge of regular lead acid batteries to establish a better method of testing.

The absolute need was that of ensuring our clients were in receipt of batteries of at least an industry accepted standard, whether new or previously used. They had to be fit for purpose.

A suspected faulty battery can also disguise a real fault elsewhere in the equipment. If unnecessarily changed, other issues perhaps relating to the charger, charging regime, controller leads, motor and brake solenoid faults, can be easily missed. These can result in repeated visits to a client, wasting time, money and trying everyone's patience.

In addition to all of this was the very important act of budget control, i.e. *SPENDING WISELY!*

Background

Both the repairs team and rehabilitation engineers reviewed the existing method of battery testing and record keeping. There was no formal method of recording tested battery results.

There was no standard operating procedure (SOP) for testing batteries. The existing test methods were two-fold:

The first method was the simple load test as one might do with a car battery, using a Clarke CVT1 battery tester. Whilst this method gives a rapid, almost instant, report on battery condition, it gives its report as a measure of CCA (cold crank amperage) and as being simply good, fair or bad.

This instant report is related to the actual CCA value of the battery which, of course, GEL batteries used in powered wheelchairs are not measured in. They tend to be measured in amp hours (Ahr or AH). In addition, the CVT1 method subjects the battery to a heavy load. This generates heat, can be allegedly dangerous with some batteries in a particular state, and reduces the life of a battery.

Although the report given with this method is not conducive with Ahr/GEL batteries, it can be undertaken "on the road" when an engineer is faced with a suspect battery.

The second method would happen only in the repairs workshop, using a rather old but still functional Emrol BATTEST 10-20-4. This method involves fully charging two batteries in series, using the regular power wheelchair's 24VDC charger for a period of 8 hours. The charged batteries are then connected to the Emrol and subjected to a constant 20Amp discharge test. Depending on the battery size and condition, the discharge can take many hours to perform with each battery singularly.
The machine and method is reported to be accurate to 1% (although the machine itself had not been tested/calibrated for many years). In the event that the end of the test had been incorrectly completed (by human error), or there were to be an irregular result, the whole procedure would need to start again.
The battery would need to receive another full charge over 8 hours.

Discussion
Firstly, we understood the need to be able to identify each battery.
Using our existing stock control system, we ensured each and every battery that moved within our repairs workshop received a stock code and asset number. The asset number is now the definitive identifier.
Every battery, when tested using the revised method, would now have its test results recorded against its asset number.
Every battery would now have a label attached showing its test result, dated and signed (initialled).
These three points became the basis of our SOP for battery testing.

The testing began…..

All the batteries stacked up for collection by the recycling agent were stopped from leaving the premises. Each battery was tested using the ACT GoldPlus following our newly written SOP.

In that first testing session of just four weeks, batteries to the estimated purchase value of £3000 were prevented from being taken away by the recycling agent - he wasn't happy!

Manufacturers of GEL batteries have varying recommendations for when they should be changed. Some say 60% of rating, others say 65%. We have decided that any battery that has a remaining current capacity of 70% or more will continue to be used.

References

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http://batteryuniversity.com/
Battery Stuff
http://www.batterystuff.com/
MK Battery
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