Sehr geehrte Mitglieder,

aufgrund des erreichten technischen Konsenses und der positiven Übereinstimmung eines Arbeitskreises von Vertretern interessierter Kreise senden wir Ihnen den Text der o.g CEN-Fachvereinbarung.


Diese CEN-Fachvereinbarung kann in keiner Weise als eine durch CEN und ihre Mitglieder entwickelte offizielle Norm betrachtet werden.

Mit freundlichen Grüßen

A list of the individuals and organizations which supported the technical consensus represented by this CEN Workshop Agreement is available to purchasers from the CEN Management Centre. Comments or suggestions from the users of this CEN Workshop Agreement are welcome and should be addressed to the CEN Management Centre.

This Workshop Agreement is circulated in accordance with the decisions of the Administrative Board and Resolution CA 31/1997.

This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its Members.

Yours faithfully,

STEPHEN RUSSELL
Director, Standards Management

Dear Members,

Further to the technical consensus reached and favourable agreement by a Workshop of representatives of interested parties, please find enclosed the text of the above mentioned CEN Workshop Agreement.

The formal process followed by the workshop in the development of this Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN Management Centre can be held accountable for the technical content of this CEN Workshop Agreement or possible conflicts with standards or legislation.

La liste des individus et des organisations qui ont soutenu le consensus technique représenté par ce CEN Workshop Agreement est disponible auprès du Centre de Gestion du CEN. Commentaires et suggestions de la part des utilisateurs de ce Workshop Agreement sont bienvenus, et doivent être adressés au Centre de Gestion du CEN.

Ce Workshop Agreement est distribué selon les décisions du Conseil d’Administration et selon la Résolution CA 31/1997.

Ce Workshop Agreement ne peut en aucun cas être considéré comme une norme officielle du CEN et de ses Membres.

Veuillez agréer, Chers Membres, l'expression de nos sentiments distingués.

Chers Membres,

Suite à l'établissement d'un consensus technique et à l'accord favorable d'un Workshop de représentants des parties intéressées, nous vous prions de trouver, ci-joint, le texte du CEN Workshop Agreement mentionné ci-dessus.

Le processus formel mis en œuvre par le Workshop pour le développement de ce Workshop Agreement a été entièrement par les Membres nationaux du CEN, mais ni les Membres nationaux du CEN, ni le Centre de Gestion du CEN ne peuvent être tenus pour responsables du contenu technique de ce CEN Workshop Agreement ou de possibles divergences avec des normes ou avec la législation.

Rue de Stassart, 36 • B-1050 Bruxelles
Tel : +32 2 550 08 11 • Fax : +32 2 550 08 19
Test and evaluation of demining machines

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which is indicated in the foreword of this Workshop Agreement.

The formal process followed by the Workshop in the development of this Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN Management Centre can be held accountable for the technical content of this CEN Workshop Agreement or possible conflicts with standards or legislation.

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This CEN Workshop Agreement is publicly available as a reference document from the CEN Members National Standard Bodies.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.
CEN Workshop Agreement for Demining Machines

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which was supported by CEN following the public call for participation made on (date).

A list of the individuals and organizations which supported the technical consensus represented by this CEN Workshop Agreement is available to purchasers from the CEN Management Centre. These organizations were drawn from the following economic sectors (non governmental organizations, national authorities and producers and users of demining equipment).

The formal process followed by the Workshop in the development of this CEN Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN Management Centre can be held accountable for the technical content of this CEN Workshop Agreement or possible conflict with standards or legislation. This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its members.

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Comments or suggestions from the users of this CEN Workshop Agreement are welcome and should be addressed to the CEN Management Centre.
CEN Workshop Agreement for Demining Machines

1 Introduction

Test standardisation for demining machines will support the development of new demining tools and methods and make it easier to compare different existing tools and products. Standardisation will also significantly improve the efficiency of demining programs. The benefits of agreed-upon specifications are world-wide and urgently needed.

The CEN Workshop Agreement (CWA) which follows is the result of a Swedish EOD and Demining Center (SWEDEC) initiative, with participation from the Croatian Mine Action Center (CROMAC), Croatian Mine Action Center- Center For Testing, Development and Training (CROMAC-CTDT Ltd) and the Geneva International Center For Humanitarian Demining (GICHD), that culminated in European Commission funding of a workshop to develop a CWA for testing of mechanical demining machines. The CWA was developed under SWEDEC leadership and secretariat at SIS over four (4) workshop meetings in Sweden and Croatia. The development was supported by the following who provided knowledgeable experts in demining equipment testing: International Test and Evaluation Programme (ITEP), countries: (Canada, Germany, Sweden, United Kingdom, United States of America) and the ITEP Secretariat; two (2) governmental organisations (CROMAC, GICHD); two (2) government agencies (Swedish Rescue Services Agency (SRSA), Swedish Defence Research Agency, (FOI)); two (2) non-governmental organisations (Norwegian Peoples Aid, International Trust Fund For Demining and Mine Victims Assistance), three (3) equipment manufacturers (Scandinavian Demining Group, DD Special Vehicles Ltd, Dok Ing d.o.o.) and one (1) government laboratory (Bundesanstalt Für Materialprüfung). It was developed within a framework contract between CEN and EU DG AIDCO.

This CWA specifies a systematic and stepwise approach. The reason is from a technical point of view but most important are concerns about the security for personnel. The first task is to provide the terms of reference for comparing present testing techniques and instrumentation and for improving and optimising existing technologies (development or improvement of new mechanical methods, standardisation of test mines, etc.). This CWA is a critical step in the development of new technologies. Having a CWA in place that manufacturers follow would contribute to the credibility of a new product when it is introduced into the market.

This CWA will help users find the key technique or the key combination of techniques best suited to a given mine-clearance operation. The importance of the CWA has therefore been stressed in terms of a collaborative effort conducted between developers and end users. It is for this reason that both machine manufacturers and in-field operators were invited to participate in the discussions. The CWA covers the following:

- Performance testing
- Survivability testing
- Acceptance testing
- Test targets
2 Background

Test and evaluation specifications and test methodology for demining machines need to be developed for the following reasons:

— Although a lot of test and evaluation work is performed in the demining world today, in many instances, it is not what most of the demining community or developers need. To improve this situation it is necessary to provide a CWA whereby each piece of equipment would be tested under the same conditions, using criteria that can withstand technical scrutiny.

— The test and evaluation shall provide users and donors with useful and reliable data. This will permit users, donors, and others to assess the effectiveness and efficiency of particular equipment to improve operational effectiveness and safety in demining operations.

— Important spin-offs are expected from well-executed, standardised test and evaluation. Manufacturers will be aware that the requirement of the CWA must be met and will design and develop the equipment to meet those criteria. At a very early stage, poor candidates can be eliminated. Persons tasked with test and evaluation would be able to plan and execute the work much more efficiently if the protocols and CWA are clearly defined. Their results will gain greater acceptance and credibility when the protocols and CWA are carefully followed.

— Much of the test and evaluation being performed today is done on the basis of local experience and conditions. Some characteristics being tested have little bearing on the requirements of demining. In other cases, whole aspects of demining are left out because of a number of constraints—testing is too expensive, takes too much time, lack a proper procedure, etc.

Many trials of the capabilities of mechanical demining equipment have been conducted in recent years, stimulated by the growing international effort to combat the threat posed by mines and unexploded ordnance to civilian populations. However, there is no standardised methodology for the conduct of such tests. The ability of one organisation to assess the findings of another’s test for their own purposes has been limited. This CWA will be a benchmark for testing.

3 Aim and objectives

The aim of this CWA is to create industry-accepted criteria for the testing, evaluation, and acceptance of mechanical demining equipment. This CWA is also intended for use as a tool for type testing of Demining Machines in serial production.

4 Scope

The scope of the CWA is to provide standardized methodology for testing and evaluation of Demining Machines. It gives technical criteria for the following:

— Performance test
  A test to establish whether the machine and its tool is capable of performing the role for which it is intended under comparable and repeatable conditions and to evaluate the manufacturer’s specifications. See Annex 1.

— Survivability test
  A test of the effects of explosive forces on the machine and operators. The explosive force used will be based on the level of threat against which the machine is designed. See Annex 2.

— Acceptance test
  A test to ensure that the machine is able to work in the environment where it is intended to be used. The criteria shall provide guidelines for local authorities when accrediting machines. See Annex 3.
5 Test targets
Requirements for targets used in the above tests. See Annex 4.

For the purposes of this document, demining machines are defined as those machines whose stated purpose is the detonation, destruction or removal of landmines. This does not necessarily imply a fully demined area following passage of the machine. Ground preparation machines are those which are primarily intended to improve the efficiency of subsequent demining activities such as manual demining. This may include breaking of hard ground, vegetation cutting, fragment removal, or rubble removal. It may or may not involve the detonation, destruction or removal of landmines.

It is recognised that this CWA concentrates on the testing of machines employed to clear mines, and there is a need to expand future work to address a number of issues, including:

Appropriate testing for ground preparation devices, including test of
a) vegetation clearance;
b) hard ground breaking;
c) fragment removal;
d) rubble removal;
e) enhancement of testing of operator/crew safety, through development of the current survivability tests;
f) possible degradation of performance due to the presence of blast resistant mines;
g) possible degradation of performance due to the presence of environmental factors such as ditches, rocks, wires, rough ground, etc;
h) enhancement of mobility testing beyond that currently in the pre-test assessment.

It is intended that future work should be able to expand the scope of this CWA to cover these points. It is also acknowledged that the current version of this document is written with an apparent bias toward flails and similar machines. It should be noted that other machines including rollers could be tested equally well using these same procedures. In addition, machines intended to remove mines (versus triggering or breaking them) such as sifters, could be tested simply by modifying the test sheets to delete the reference to mines being triggered or neutralized and changing it to mines being successfully removed.

Finally the test and evaluation procedures specified herein should be viewed as minimum requirements. Additional or more stringent requirements can be imposed if appropriate. Some care should be taken, however, that such changes do not compromise the intent of the tests or the ability to compare test results.

5 Classification of machine

5.1 Classification according to weight, mode of operation and tool

Machines are classified as follows:

5.1.1 Classification according to machine weight

— Light, up to 5 tonnes
— Medium, 5-20 tonnes
— Heavy, more than 20 tonnes
5.1.2 Classification according to mode of operation

— Direct operation from the cabin of the machine
— Operation with remote controls
— Operation with remote controls and video monitoring

Dual classification for direct and remote operation is possible. In this case the machine shall only be accredited for the classification in which it was tested.

5.1.3 Classification based on tool

— Machine with flails
— Machine with a mill
— Machine with a vegetation cutter
— Others

5.2 Performance requirements for each weight class

— *Light* machines shall only have the capacity to destroy antipersonnel (APM) mines but shall be tested against 8 kg explosives for reasons of survivability.
— *Medium* machines shall have the capacity to destroy both APM and antitank mines (ATM).
— *Heavy* machines shall have the capacity to destroy both APM and ATM.

6 Flowchart of Steps in the CWA
7 Modifications or changes to the demining machines or standard operating procedure

If during the mine action program changes are made to the machine or the SOP that could have influence on the capability of the machine, the testing organisation or the national mine action authority may ask for a revision of certification. For this reason the owner/user organisation shall inform the certifying organisation about all modifications planned for the machine or the SOP and other changes. The testing organisation will determine if the expected changes require a repetition of the evaluation, in whole or in part and whether such testing can be met by an engineering review of field tests.

8 Pre-test conditions

The following information shall be provided by the manufacturer before any testing.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Performance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over All data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Driving speed km/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Capacity for vegetation cutting</td>
<td>m²/h</td>
<td>Conditions: terrain and vegetation to be reported in accordance with annex 3 clause 6</td>
</tr>
<tr>
<td>in light and heavy vegetation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Operating speed and clearance depth</td>
<td>/m/min -cm</td>
<td>Terrain conditions shall be reported in accordance with annex 3 clause 6</td>
</tr>
<tr>
<td>in varying terrain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Contouring system</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>5 Speed-control system</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>6 Maximum and minimum operating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Maximum operating range from remote</td>
<td>m</td>
<td>Mode of operation when out of range or in case of communication failure</td>
</tr>
<tr>
<td>control unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Maximum climb slope while operating</td>
<td>degrees</td>
<td></td>
</tr>
<tr>
<td>9 Maximum descending slope while</td>
<td>degrees</td>
<td></td>
</tr>
<tr>
<td>operating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Maximum traversing slope while</td>
<td>degrees</td>
<td></td>
</tr>
<tr>
<td>operating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Height m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Weight tonnes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Daily servicing schedule hours</td>
<td></td>
<td>Machine working hours</td>
</tr>
<tr>
<td>14 Transportability</td>
<td></td>
<td>Shorter distances. By its own. Km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Longer distances. Need of transport equipment?</td>
</tr>
<tr>
<td>Specification</td>
<td>Performance</td>
<td>Remarks</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>15 Documentation requirements</td>
<td>Users manual Service and repair documents Wiring diagram Spare part catalogue Failure Mode Effects and Criticality Analysis (FMECA), (if available) Consumption records Service maintenance schedules</td>
<td></td>
</tr>
<tr>
<td>16 Protection Machine survivability Crew survivability (where applicable)</td>
<td>Description of armour with supporting documents Description of crew escape routes and fire suppression</td>
<td></td>
</tr>
<tr>
<td>17 Reliability The machine shall operated under load for minimum of 48 hours over a 6 consecutive days</td>
<td>time/depth /m² Records of: fuel consumption oils and coolant temperatures taken hourly spare parts used consumables failures maintenance soil and vegetation conditions reported in accordance with annex 3 clause 6</td>
<td></td>
</tr>
<tr>
<td><strong>Vehicle data</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Turning circle</td>
<td>m Minimum turning radius</td>
<td></td>
</tr>
<tr>
<td>19 Length</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>20 Width</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>21 Maximum fording depth</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>22 Gap crossing capability</td>
<td>m Width of a ditch which a machine can traverse</td>
<td></td>
</tr>
<tr>
<td>23 Axle weights</td>
<td>tonnes</td>
<td></td>
</tr>
<tr>
<td>24 Wheel spacing</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>25 Wheel/track footprint</td>
<td>mm × mm</td>
<td></td>
</tr>
<tr>
<td>26 Ground bearing pressure</td>
<td>kPa</td>
<td></td>
</tr>
<tr>
<td>27 Power requirement to drive the vehicle (if available)</td>
<td>kW On flat ground without the tool in operation</td>
<td></td>
</tr>
<tr>
<td>28 Engine power at the flywheel</td>
<td>kW</td>
<td></td>
</tr>
<tr>
<td>29 Fuel consumption under normal operation</td>
<td>litres/hour</td>
<td></td>
</tr>
<tr>
<td>30 Fuel tank capacity</td>
<td>litres</td>
<td></td>
</tr>
<tr>
<td>Specification</td>
<td>Performance</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------</td>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>Tool Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 Clearance width</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>32 Maximum angle of depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 Maximum angle of elevation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 Tool width</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>35 Beat pattern</td>
<td>hits per m²</td>
<td>At operating speeds defined in line 2</td>
</tr>
<tr>
<td>36 Power at the working tool</td>
<td>kW</td>
<td></td>
</tr>
<tr>
<td>37 Tool operating speed</td>
<td>Rpm</td>
<td>Where applicable</td>
</tr>
</tbody>
</table>
Performance Test of Demining Machines

1 General

The purpose is to test, in an objective and repeatable manner, the performance of mechanical mine-clearance devices and ground-preparation systems used in the context of humanitarian mine action, to identify equipment that is safe, reliable, and fit for its purpose.

Machines not designed to have a clearance capability, for example vegetation cutters and ground preparation machines, will be tested in accordance with paragraph 4-7 in this annex.

Results are based on test conditions and may not necessarily be repeated in field conditions.

2 Clearance test

The purpose of the clearance test is to test, under controlled conditions, the capability of the machine to clear (i.e., detonate, destroy or remove) mines at different depths in different types of soil. The test is performed in three different ground configurations at various depths from flush with the surface to the maximum penetration depth (according to the manufacturer).

2.1 Test environment

Three lanes each with a homogenous soil type. The soil in the lanes shall be separated from the surrounding soil. The lanes shall have such width and depth that the machine and its tool will not interfere with the soil outside the lane.

2.2 Soil types

Gravel with particle size from 0,075 mm to 45 mm, of which 10 % is less than 0,4 mm, and then a size distribution up to 45 mm normally specified as 0-32 mm.

Sand (e.g. with particle size from 0,075 mm to 20 mm, with 85 % less than 0,6 mm).

Topsoil may have different contents of organic material. Locally available topsoil is accepted but the particle size shall be from 0,001 up to 31 mm.

Before every run the soil shall be cultivated, or otherwise loosened up, and then compacted to its original state again. The level of compactness is to be measured and recorded using 10 points randomly distributed along the lane. The measurement shall be done with a densiometer and at the expected clearance depth.

Gravel 94 % average of the measurement ± 2 % (e.g. 94 % of the maximum theoretical dry density)

Sand 90 % average of the measurement ± 2 %

Topsoil 85 % average of the measurement ± 2 %
2.3 Execution

The machine shall be driven at normal clearance speed through the whole length of the test lanes.

An example of the test protocol can be seen in example 1. Manufacturers are responsible for supplying operators for the operation of the machine during the testing period.

The tests will be conducted as follows:

- Sand 50 APM test targets at three different depths, total 150
- Gravel 50 APM test targets at three different depths, total 150
- Topsoil 50 APM test targets at three different depths, total 150

2.4 Target selection

The standard target defined in Annex 4 shall be used for performance clearance.

ATM test targets will be used if the manufacturer considers the machine to be a mine clearance vehicle (MCV) for ATM.

2.5 Target deployment

The mines are laid at three depths: flush with surface, 10 cm and the IMAS specified clearance depth or the depth claimed by the manufacturer, whichever is the greater. The target mines shall be laid without pattern along the lane within the following constraints: mines shall not be within 0.5 m of each other and shall be distributed to cover 50 % of the width of the working tool. The targets shall be placed creating the minimum disturbance to the surrounding ground (e.g., using an earth auger).

Key

1 Measurement of depth
2 Flush with surface

Figure 1 — Charge placement for performance test
2.6 Tool penetration profile

To evaluate the penetration profile during the clearance probability test, sections of 3 mm fibreboard will be put into the ground, across the clearance path of the machine, buried up to 15 cm below the maximum depth. The width of the fibreboard shall be at least 10 % greater than the width of the digging tool. Joining of several sections to achieve the required width is acceptable. A minimum of 3 fibreboards is to be used, one before the targets, one within the targets, and one after the targets. See Figure 2.

The machine shall be allowed to stabilize itself and drive 5 meters before the measurement starts.

2.7 Defining the clearance result

The following definitions are provided to describe the condition of targets as a means of evaluating the resulting effect of the machine on the targets. (See Annex 4).

Test target will be recorded as:

— **Triggered (detonated)**
  The firing chain or circuit has been completed.

— **Mechanically neutralized (untriggered, damaged, non-functional)**
  The target has been engaged by the tool, and the firing chain or circuit cannot be completed.

— **Live damaged (untriggered, damaged, still functional)**
  The tool has engaged the target, but the possibility of the firing chain being completed exists.
— Live (untriggered, undamaged)
   The target has not been engaged by the tool, and the firing chain or circuit remains active.

All test reports shall include photographs indicating examples of the conditions in the test lanes, fibreboards showing the clearance profile and target's functioning mechanism.

3 Interpretation of clearance test result

3.1 Definitions

Confidence interval
A confidence interval gives an estimated range of values which is likely to include an unknown population parameter, the estimated range being calculated from a given set of sample data.

Confidence level
The confidence level is the probability value associated with a confidence interval, the probability that the unknown parameter is included in the confidence interval.

3.2 Test conditions

The result from the performance test, (the number of mines cleared), is an estimate of the machines ability to clear mines. Before any conclusion can be drawn from the estimate of the machines real performance, the confidence of the estimate has to be calculated based of a statistical distribution. In this test the binominal distribution can be used if:

— the test has two mutually exclusive possible outcomes, success or failure. In this test the target is cleared or not cleared.

— the probability for clearing a target is the same for all targets in the test.

— the outcome from clearing one target does not affect the outcome for another target.

The parameters that are known to affect the result shall be controlled and kept the same for each test run. These parameters are:

a) type of target

b) depth of the target

c) type of soil in the test lane

The parameters that we do not know if they affect the result shall be randomized. The only parameter of this kind in this type of test is the position of the targets in the test lane. To place the targets randomly a predefined patterned shall be used or a tool that can generate random patterns, e.g. Excel. A person deploying targets does not give a random pattern.

3.3 Interpretation

The uncertainty of the estimate, the confidence interval, is presented in Figure 1. The horizontal axis, the x-axis, is the number of targets, out of the 50 in the test cleared by the machine. The vertical axis, the y-axis, is the performance in percentage and the two curves in the figure denote the upper and lower edge of the confidence interval, i.e. the performance of the machine is between the lines. The confidence level for the curves in Figure 1 is 95 %, i.e. the probability that the interval includes the performance of the machine is 95 % or the risk that the machines performance is outside the interval is 5 %.
Figure 1 — Uncertainty of the estimate

The figure shows confidence intervals at the confidence level 95 %.

Example   A machine cleared 46 of the 50 targets in a performance test. The lower curve figure 1 crosses 46 at 86 % on the vertical axis, i.e. the lower limit of the confidence interval is 86 %. The upper curve crosses 46 at 99 %, i.e. the upper limit of the confidence interval is 99 %. The confidence interval is 86-99 %, or the performance of the machine is in the interval 88-99 % at the confidence level 95 %.

In the situation that the performance of two machines shall be compared, Figure 2 shall be used.

The question now is how big the difference in the estimates of the performance rate has to be before we can say that there is a significant difference in the performance of the machines. In Figure 2 the horizontal axis is the estimated performance of the machine with the highest estimated performance. The vertical axis is the estimated performance for the second machine. If the estimated performance for the second machine is below the curve then there is a significant difference between the machines.

Also in this figure the confidence level is 95 %, i.e. using the table there is a 5 % risk that the conclusion is wrong.
Example Machine A cleared 46 of the 50 targets. Machine B cleared 43 in the same type of test. 46 at the horizontal axis cross 43 at the vertical axis above the curve in the figure. The conclusion is that there is no significant difference between Machine A and Machine B.

In the case where a small number of targets cannot be accounted for, the missing targets shall be plotted in two ways to allow the reader to draw his/her own conclusions. (i) assuming the missing mines were triggered, (ii) assuming the missing mine is live and functional. Obviously, if a large number of targets cannot be accounted for, the test should be repeated.
4 Ground preparation and vegetation clearance

Because no standard methodologies have as yet been developed for the establishment of repeatable conditions for testing vegetation clearance, the aim of the test is to demonstrate that the machine has a capability for vegetation clearance in three different environments. However, it may be possible to include more comprehensive test in the future.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>VEGETATION DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW VEGETATION</td>
<td>- Green or dry grass, thin or thick, weeds, few low bushes up to 1 m high</td>
</tr>
<tr>
<td>MEDIUM VEGETATION</td>
<td>- Grass, weeds, individual bushes, medium to high density, 1-2 m high</td>
</tr>
<tr>
<td></td>
<td>- Few individual trees up to 10 cm in diameter</td>
</tr>
<tr>
<td>HIGH VEGETATION</td>
<td>- Bushes, weeds, grass</td>
</tr>
<tr>
<td></td>
<td>- High density</td>
</tr>
<tr>
<td></td>
<td>- Greater than 2 m high</td>
</tr>
<tr>
<td></td>
<td>- Individual trees with diameter greater than 10 cm</td>
</tr>
<tr>
<td>SPECIFIC CONDITIONS</td>
<td>- Specific conditions where the other classes are not applicable</td>
</tr>
<tr>
<td></td>
<td>- To be described in the report</td>
</tr>
</tbody>
</table>

The machine shall work through 10 meters of vegetation as based on the worst case scenario available. After 2.5 metres a 3 mm fibreboard shall be put in the soil 15 cm deeper than the estimated working depth to give the penetration profile. Machines constructed not to engage the ground shall not be subject to the fibre board test.

Ground preparation machines, not intended for vegetation cutting, shall prepare 10 meters of ground based on the worst case scenario available. After 2.5 metres a 3 mm fibreboard shall be put in the soil 15 cm deeper than the estimated working depth to give the penetration profile.

The report shall include a narrative description of the results supported by photographs before and after the clearance.

5 Reliability and maintainability of machine

Assess manufacturer’s documentation and data on reliability and maintainability, including the effect of the environment (e.g., dust, water, and heat) on the machine. The organisation performing the test shall manage at least 8 hours of continuous operation of the machine under maximum load (depth). Stops for refuelling and scheduled maintenance are allowed within this time period. The operation does not need be performed in the test lane with target mines. A daily log shall be kept, accurately recording all performance data and assessing manufacturer’s claims.

6 Logistic issues

Evaluate and report based on manufacturer’s data as far as reasonably practical within the test aims and conditions.
7 Human Factors

Evaluate and report on human factors such as visibility, comfort, and ergonomics to the extent reasonably practical within the test aims and conditions.
# Test Protocol Mechanised Mine-Clearing Vehicles

<table>
<thead>
<tr>
<th>Date:</th>
<th>Weather:</th>
<th>Temperature:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground conditions:</td>
<td>Status:</td>
<td>Place:</td>
</tr>
<tr>
<td>Rate of compaction:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Scope:**

Performance in topsoil, mine flush with surface, 10 cm below surface, and at maximum clearance depth or 20 cm, whichever is less.

**Equipment:**

3 fibreboards used at beginning, middle and at the end of run.

**Sketch/description**

- Penetrating profile will be evaluated
- Transmission/speed control will be evaluated
- Clearing speed will be recorded

**Comments and results:**

---

Example 1

```plaintext
3 mm fibreboard
```

---

Test leader:  
Signature:  

---
## Test protocol

<table>
<thead>
<tr>
<th>Machine type</th>
<th>Manufacturer</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Weather</th>
<th>Temperature</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Test number/ Deployment depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Rate of compaction</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Clearance depth</th>
<th>Time/50 m</th>
<th>Operating speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m/min</td>
</tr>
</tbody>
</table>

## Number of targets

<table>
<thead>
<tr>
<th>Deployed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Triggered (detonated)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanically neutralized</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Live damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

## Comments:

Accounted for: Example: 48/50, (48 accounted for out of 50 deployed)

NOTE All reasonable steps shall be taken to find the targets
Survivability test of Demining Machines

1 General
Survivability is based on the materials used, design features, and threat for which the machine has been designed. The tests focus on two distinct areas (detailed below):

1. Machine survivability - the blast effect from mines on the machine.
2. Operator survivability - the level of protection afforded to operators subjected to the effects of blast.

Before testing, the test agency shall evaluate at a minimum the protection specifications, which shall include (but not be limited to) the following:

— Materials used (types, thickness, certificate, etc.);
— Design principles (blast deflection, distances, etc.);
— Construction quality (access of fittings and controls, welds, etc.);
— Safety principles (such as exits, fire suppression, etc.)

2 Machine survivability

2.1 Test conditions
Blast effects on the tool will be measured under controlled conditions using charges as specified in this CWA and with the tool in normal operation. The size and characteristics of the charges are defined in Annex 4. The target selection will be based on the manufacturers declaration of capacity unless otherwise agreed to in the test documentation. As a minimum the machine shall be subjected to testing of APM.

2.2 Execution

2.2.1 Placement of charges
The smallest charge shall be placed first to avoid unnecessary damage. The first charge will be placed in the centre of the tool. Depending on the result, a second charge of equal effect will be detonated at the end of the tool. All charges shall be remotely detonated.
The placement and condition of the charges in respect to the tool are shown in Figure 1.

![Figure 1 - Charge placement for machine survivability tests](#)

**Key**

1. Example of working tool

2.3 Data collection and information management

Manned machines will also have the effects of the blast on the operator measured and recorded.

3 Operator survivability

3.1 Aim

The aim is to verify the survivability of the crew after AT mine detonation in a worst case scenario based on a charge no smaller than the ATM charge agreed to by the CWA.

The following effects will be measured and evaluated:

- Overpressure in internal organs (ear);
- Acceleration (feet and spinal);
- Displacement of operator.

3.2 Execution

3.2.1 Placement of charges

The charge will be placed in the area deemed most likely to have maximum effect on the operator (worst case scenario) e.g. under the wheel or track bogey closest to crew compartment. Charge placement will be in direct contact with the target area. All charges will be initiated remotely.

3.2.2 Data collection and information management

Acceptance Tests of Demining Machines

1 General

The purpose is to accredit a machine to be used for humanitarian demining. Prior to the acceptance test the acceptance testing organisation shall, evaluate the results from performance and survivability test and declare the machine as safe for the acceptance test.

2 Principles

— The first phase involves provisional evaluation on the basis of analysing the documents submitted by the testing applicant. This documentation includes that provided by the manufacturer, test results from previous performance and survivability tests, and other relevant documentation.

— The second phase involves a test under real conditions to verify that the personnel, equipment, material, and procedures can be used as intended, and that demining activities can be conducted in a safe, efficient, and effective way.

— Modifications or changes on the demining machines or in its standard operating procedure (SOP)—If during the mine action program significant changes are done on the machine or in the SOP that could have an influence on the capability of the machine, the testing organisation or the national mine action authority may ask for a revision of certification. For this reason the owner/user organisation will inform the certifying organisation of all modifications planned for the machine or the SOP, as well as other changes. The testing organisation will determine if the expected changes require a repetition of the evaluation, in the whole or in part and whether such testing can be met by an engineering review of field test.

— Subject to national authority regulations, this acceptance process should lead to certification of the machine for use in that country.

3 Requirements

3.1 Classification of machine

Machines are classified as follows:

3.1.1 Classification according to machine weight

— Light – up to 5 tonnes

— Medium – 5-20 tonnes

— Heavy – more than 20 tonnes
3.1.2 Classification according to mode of operation

- Direct operation from the cabin of the machine
- Operation with remote controls
- Operation with remote controls and video monitoring

3.1.3 Classification based on tool

- Machine with flails
- Machine with a mill
- Machine with a vegetation cutter
- Others tools

3.2 Performance requirements for each weight class

- *Light* machines shall only have the capacity to destroy antipersonnel (APM) mines.
- *Medium* machines shall have the capacity to destroy both APM and antitank mines (ATM). Limitation to APM may be specified by the manufacturer in pre-test conditions.
- *Heavy* machines shall have the capacity to destroy both APM and AT.

4 Basic preconditions

The minimum conditions for obtaining and keeping a certification for a demining machine are the following:

- That the testing applicant is capable of meeting the provisions of this Agreement.
- A machine will be awarded the certification only if it meets the standards set down in this Agreement and national regulations.

NOTE If a testing organisation deems that not all the requirements for accreditation and licensing have been met, it shall inform the testing applicant as soon as possible. It shall also identify the problems and propose the corrective measures to be taken. The testing applicant shall show what modifications it has made to fully meet the requirements.

5 Provisional evaluation

Upon receiving the application and related documents, the testing organisation will confirm the receipt and, if needed, ask for additional information from the applicant.

The evaluation based on the document analysis may end with the issue of a test certificate, based on the following: That the demining machine in question has been tested already in accordance with this Agreement, or that, prior to the adoption of this agreement, it has been used in a safe and effective way in demining operations. The conditions for such post-facto approval shall be decided by the national mine action authority.

If a demining machine does not meet all of the above criteria, it will have to go through the relevant tests as required.
If the testing organisation deems that not all the accreditation and licensing requirements have been met, it shall inform the testing applicant as soon as possible and it shall set out the grounds for denying the application. Whenever possible, the applicant shall be given the opportunity to fill in the gaps in a time frame to be agreed between the applicant and the testing organisation.

If the testing applicant cannot meet the accreditation and licensing requirements and cannot correct the failures within the agreed time frame, the application shall be rejected and the applicant shall be informed.

6 Acceptance test – real conditions

The purpose is to verify that a demining machine and operational procedure proposed by the testing applicant in its application are safe, effective, and efficient.

6.1 Classifications of test environment

6.1.1 Classification of soil

The soil in the area for the test shall be classified and reported with the results from the test.

The specifications of the classes are as follows:

<table>
<thead>
<tr>
<th>CLASS</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS I</td>
<td>▪ Humus, loam, compact sand, hard and semi-hard soil covered in vegetation</td>
</tr>
<tr>
<td></td>
<td>▪ Use of manual tools (shovel, pickaxe)</td>
</tr>
<tr>
<td></td>
<td>▪ Work with prodder in accordance with the rules</td>
</tr>
<tr>
<td>CLASS II</td>
<td>▪ Dirt mixed with stone, dirt is prevailing, rare vegetation</td>
</tr>
<tr>
<td></td>
<td>▪ Limestone, soft, easily crushed by demining machine tool</td>
</tr>
<tr>
<td></td>
<td>▪ Work with prodder is difficult</td>
</tr>
<tr>
<td>CLASS III</td>
<td>▪ Stony terrain, stone plates with dirt in between, low vegetation in places</td>
</tr>
<tr>
<td></td>
<td>▪ Semi-hard stone</td>
</tr>
<tr>
<td></td>
<td>▪ Machine works in reduced depths (10-15 cm)</td>
</tr>
<tr>
<td></td>
<td>▪ Prodder could only be used in some places</td>
</tr>
<tr>
<td>CLASS IV</td>
<td>▪ Specific conditions where the other classes are not applicable</td>
</tr>
<tr>
<td></td>
<td>▪ Difficult to work with the machine with acceptable result</td>
</tr>
<tr>
<td></td>
<td>▪ To be described in the report</td>
</tr>
</tbody>
</table>
6.1.2 Classification of vegetation

The specifications of the classes are as follows:

<table>
<thead>
<tr>
<th>CLASS</th>
<th>VEGETATION DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW VEGETATION</td>
<td>- Green or dry grass, thin or thick, weeds, few low bushes up to 1 m high</td>
</tr>
<tr>
<td>MEDIUM VEGETATION</td>
<td>- Grass, weeds, individual bushes, medium to high density, 1-2 m high</td>
</tr>
<tr>
<td></td>
<td>- Few individual trees up to 10 cm in diameter</td>
</tr>
<tr>
<td>HIGH VEGETATION</td>
<td>- Bushes, weeds, grass</td>
</tr>
<tr>
<td></td>
<td>- High density</td>
</tr>
<tr>
<td></td>
<td>- Greater than 2 m high</td>
</tr>
<tr>
<td></td>
<td>- Individual trees with diameter greater than 10 cm</td>
</tr>
<tr>
<td>SPECIFIC CONDITIONS</td>
<td>- Specific conditions where the other classes are not applicable</td>
</tr>
<tr>
<td></td>
<td>- To be described in the report</td>
</tr>
</tbody>
</table>

7 Acceptance test procedure

7.1 Test conditions

Testing of a demining machine on APM and ATM is executed outside a work site, on a surveyed and safe ground, with all protection measures not endangering human lives or damaging material goods.

When a machine is operated by remote controls, the operator could be situated in a supporting armoured vehicle, or walking, on safe ground, behind the machine, wearing protective equipment:

a) The supporting armoured vehicle moves/stands behind the demining machine at a safe distance on land that has been surveyed and has been determined as safe.

b) The operator is located in the armoured vehicle on a seat with the safety belt. The operator wears a flak jacket and a helmet with a communication system installed, for communication with the test leader and the work site.

c) The operator, wearing protective equipment, is walking/standing behind the machine at a safe distance. The operator must walk/stand on land that has been surveyed and determined as safe.
7.2 Prior to test

— Moisture content in soil to be measured.
— The soil to be classified.
— The vegetation to be classified.

7.3 Live mine test

7.3.1 Number and type of mines to be used

— APM – 20 items
— ATM – 5 items

7.3.2 Types of mines to be used

Types of mines to be used, depending on the machine type:

— The type of APM and ATM shall reflect the main mine threat in the region (see guidelines in Annex 4).
— Light demining machines and excavators are tested against APM.
— Medium-size demining machines are tested against both APM and ATM. Limitation to APM may be specified by the manufacturer in pre-test conditions
— Heavy demining machines are tested against both APM and ATM.

7.4 Deployment of mines

The national mine action authority shall determine the appropriate mines or targets to be used. For some national authorities it may be desirable to use live mines to test the interactions between the machine and the mine, or to give the machine operator a sense of confidence in the machine. For other authorities the use of live mines may create unacceptable safety or logistics concerns. The individual national mine action authorities must determine the goals of the acceptance tests and the restrictions under which those tests will be conducted. Based on those decisions, the national mine action authorities will select mines or acceptable targets for use in the tests.
7.4.1 Antipersonnel mines

APM or other appropriate targets are placed in a line, with the distance between them of about 4 m and flush with surface, at the depth 10 cm and the national specified clearance depth or the depth claimed by the manufacturer, whichever is the greater and measured from surface to the top of the mine body.

Key
1 Measurement of depth
2 Flush with surface

Figure 2 - Charge placement for acceptance test

7.4.2 Deployment of fragmentation mines

Key
1 Machine
2 Tool nearest the machine
3 Fragmentation APM

Figure 3 - Set up for fragmentation mine
7.4.3 Antitank mines

— The machine is tested against one ATM in each run.
— Before the test the ATM is placed 5 m in front of the working tool at a depth of about 10-12 cm.
— The test shall start with the ATM that is estimated to have the lowest impact

7.5 Evaluation of result of the live mine test

— The working tool of the demining machine has to activate or break the mines. Broken mines shall be
evaluated in accordance with Annex 4.
— The final result shall be specified as number of mines:
  — Triggered (detonated)
  — Mechanically Neutralised (untriggered, damaged, non functional)
  — Live Damaged (untriggered, damaged, still functional)
  — Live (untriggered, undamaged)

The Parties can agree to repeat the test in case that the result is not seen as satisfactory

8 Testing of a demining machine in a mine suspected area

The testing of the demining machine shall be done in realistic conditions, in a mine suspected area. This part
of the test is carried out in accordance with the SOP that is used in the region (i.e., typical demining operation
with demining machines). During the test all activities and consumption of fuel, spare parts, etc. will be
recorded.

8.1 The minimum data to be recorded during the test

Work Log:
— The place and time of work
— Actual working time of the demining machine
— The size of the treated area (to be measured at the end of a day)
— Clearance depth (20 samples a day for 5 hours of effective work of the demining machines)
— Description of the land and vegetation
— Activating, breaking, or damaging of mines by the demining machine and the impact on the machine
— Machine breakdowns
— Standstills and reasons for standstills
— Consumption of fuel, oil, spare parts, etc.

8.2 Test areas depending on machine classification

8.2.1 Light demining machines

a) Area of 30,000 m² (3 ha)
b) Class I–III soil and class IV where applicable, flat with gentle longitudinal and transversal slopes, vegetation low to medium height

c) Presence of APM

8.2.2 Medium-size demining machines

a) Area of 50,000 m² (5 ha)

b) Class I–III soil, flat with longitudinal and transversal slopes up to 15 degrees, vegetation low and medium height

Presence of APM and ATM. Limiting the test to APM may be specified by the manufacturer in pre-test condition

8.2.3 Heavy demining machines

a) Area of 80,000 m² (8 ha)

b) Class I–III soil, flat with slight longitudinal and transversal slopes, vegetation height low, medium, and high

c) Presence of APM and ATM

8.2.4 Excavators

a) Area of 30,000 m² (3 ha)

b) Slopes of channels, rivers, ditches, and dams with vegetation of low, medium, and high height

c) Presence of APM (without ATM)

d) The machine is moving sideways on the surveyed and safe land, and the arm of the excavator and working tool treats the slope of the channel, river, dam, and ditch

e) Testing of excavators is performed according to the same principle as the testing of light machines having flails as a tool. When excavator has a vegetation cutter as a tool, the testing procedure is the same except there are no mines involved in the test

NOTE In this case we are referring to all machines that operate from safe ground.

8.3 Completion

When the machine has “cleared” the test area the result shall be evaluated through manual mine clearing methods (prodding, metal detectors, dogs etc.) to determine the clearance level and state.
Definitions for use with test targets

1 Introduction

Machine testing involves a number of different tests as outlined in Annex 1, 2 and 3, each of which requires standardised targets to ensure that test results are comparable, repeatable and credible. A variety of targets are required for different tests, it has been recognised that machines are required to undertake a range of operational functions and that all machines uses and mine threats cannot be catered for. The aim of this annex is to provide criteria and characteristics for testing agencies to develop standards for test targets.

Targets must meet the criteria and limitations of the testing agencies. There is a need to develop targets that are both explosive and non-explosive meeting both information and safety requirements.

2 Test Types

This CWA covers targets to meet the needs of the following tests:

- Performance Test (Annex 1)
- Survivability Tests (Annex 2)
- Acceptance Tests (Annex 3)

3 Target Requirements

Targets used in machine testing are used to show the effect on the targets resulting from the mechanical actions. Machine test targets need to provide the basic characteristics associated with mines. Such as:

- Shape
- Size
- Weight
- Function
- Explosive forces

4 Target Type Descriptions

This CWA is based on existing target definitions found in the JRC document, Target Standardization For Demining Testing, 20/12/1999 which breaks the range of targets into three main groups that are further divided into a number of sub-categories.

For the purposes of the different tests, any of the targets described are acceptable providing they meet the shape, size, weight, function, and explosive force effects defined.
5 Performance Tests (Annex 1)

5.1 Target Specifications

5.1.1 Target Type

— Simulated Mine – simulate generic categories of mines and do not aim to replicate specific mines. May or may not contain explosive or live fuze.

— Surrogate Mine – represents a specific mine type.

— Live Mine Targets – production mines fully functional or active fuzes. Note that such targets may damage the machine and compromise the ability to conduct the test. As such, real mines may not be a practical target for the performance tests, but are, nevertheless, permitted.

5.1.2 Measuring Results

Mechanical systems impart violence or energies on the target that can make determining the results difficult. For the results to be of value, target condition must be detailed and understandable. Any target mine selected must be able to provide this information after the machine has processed the test area. The target must be able to indicate the level of effect based on the following four descriptors:

— Triggered (detonated)

— Mechanically Neutralised (untriggered, damaged, non-functional)

— Live Damaged (untriggered, damaged, still functional)

— Live (untriggered, undamaged)

5.1.3 Definitions

— Untriggered means that the firing chain has not been completed.

— Non-functional means that the firing chain cannot be completed, the mechanism is removed from the detonator, or the detonator cannot be initiated.

— Still functional means that the firing chain can still be completed, this can include a detonator only.

5.1.4 AP Mine Target Specification

— Fuze description – The AP mine target should be pressure activated and should have a pressure plate area between 20 mm and 25 mm diameter. The fuze may or may not extend above the mine body as necessary, but the height of the external fuze section should be minimized to no more than 20 mm.

— Activation force – The AP mine target should trigger when subjected to a load between 10 kg and 15 kg. That is, a load under 10 kg should not trigger the target, and it should not take more than 15 kg to trigger the target.

— Dimensions – The AP mine target should be cylindrical in shape with an outer diameter not less than 50 mm and not greater than 75 mm. The height should be not less than 30 mm and not greater than 40 mm.
— Materials – To allow the damage levels to be evaluated in accordance with the above descriptors and for these damage levels to be comparable between different trials, it is necessary to ensure that the mechanical characteristics of the AP mine targets are similar from test to test. The AP mine target casing should be made of ABS, PVC, nylon, Delrin, HDPE, or other plastic material having similar hardness and mechanical strength characteristics. Casing thickness should be 2 mm and 4 mm. All casing components must be securely screwed, glued, welded or otherwise fastened together.

5.2 Reporting Requirements

The test results should give clear and concise records of the condition of the targets. The definitions avoid referring to hazardous and non-hazardous; this decision is beyond the scope of the test. In order to assess the results, the firing mechanism must be detailed and must include a diagrammatic view showing the method of operation, complete with supporting photographs.

6 Survivability Tests (Annex 2)

6.1 Target Specifications

6.1.1 Target Type

— Simulated Mine – simulate generic categories of mines and do not aim to replicate specific mines. Must contain explosive.

— Surrogate Mine – represents a specific mine type. Must contain explosive.

— Live Mine Targets – production mines.

Survivability tests aim to subject the machine to explosive forces and focus on two distinct areas as detailed below. As such, targets used for survivability testing do contain explosives but are initiated remotely.

Target specifications provide the basic criteria for establishing controlled blast tests. The targets can be manufactured or use appropriate live mine targets. The standards recognise the limitations faced by various agencies in obtaining live mines and certain explosive types.

6.1.2 AP mine target specifications

— Explosive fill – 240 g +/- 10 g TNT or equivalent based on brisance (6850 m/s)

— Explosive fill dimensions – 76 mm (3") nominal diameter; height to be approximately 32 mm (1.25") tall to allow 240 g TNT at 1.65g/cc density.

— Casing – the explosive fill must be fully enclosed in a plastic casing. Standard ABS or PVC plumbing pipe and fittings are acceptable as casing materials. All casing components must be securely screwed, glued, welded or otherwise fastened together.

— Initiation – the charge may be initiated remotely at the top, bottom or side as desired.

6.1.3 AT mine target specifications

— Explosive fill – 8 kg +/- 100 g TNT or equivalent based on brisance (6850 m/s)

— Explosive fill dimensions – 250 mm (9.84") nominal diameter; height to be approximately 100 mm (3.9") tall to allow 8000 g TNT at 1.65g/cc density.

— Casing – the explosive fill must be fully enclosed in a pressed steel casing measuring 1 mm +/- 0.3mm thick. All casing components must be securely welded or otherwise fastened together.

— Initiation – the charge may be initiated remotely at the top, bottom or side as desired.
7 Acceptance Tests

7.1 Target Specifications

7.1.1 Target Type

— Simulated Mine – simulate generic categories of mines and do not aim to replicate specific mines.
— Surrogate Mine – represents a specific mine type.
— Live Mine Targets – production mines