Performance Testing of CCTV Perimeter Surveillance Systems

(Using the Rotakin Standard Test Target)

J Aldridge and Sqn Ldr C Gilbert RAF

POLICE
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He that will not apply new remedies

must expect new evils,

for time is the greatest innovator.

Francis Bacon
First Baron of Verulam
Viscount of St Albans

1561 -1620

PREFACE

The increased use of sophisticated security systems has led to the need for simple tests to ensure that such systems are operational. Within Government security auditing has become accepted practice. For example, in 1989 the Rotakin approach to the performance testing of closed circuit television systems (CCTV) was introduced. The Rotakin tests meet the need for a method of commissioning that can be carried out with the minimum of training and experience.

Although the Rotakin test target provided a basis for standard performance tests its use did not, in itself, provide optimum CCTV coverage. This is because Rotakin is only one component of a new method, developed in PSDB, for achieving the best from a CCTV system. This starts from what level of performance is expected and leads to a test specification, test procedures and a method of analysing the results. Such a methodology is described in the "CCTV Operational Requirements Manual."* A written Operational Requirement (OR) is a fundamental pre-requisite to applying Rotakin test methodology.

The wide range of uses to which CCTV is put makes it impossible to provide sufficient information in one handbook to solve every problem. Although primarily concerned with CCTV systems operating in conjunction with Perimeter Intruder Detection Systems (PIDS), the methodology and procedures described in this handbook can be applied to most types of CCTV security systems.

The methodology described here is new. Suggestions for its improvement will be welcomed and registration in PSDB of the users of this document will ensure that they are kept informed of future developments.

*Copies of the CCTV Operational Requirements Manual are available from:
The Information Service, PSDB, Woodcock Hill, Sandridge, St Albans, Herts, AL4 9HQ, or by using the registration form on the next page of this document.

REGISTRATION

Please register ownership of this version or apply for your own, by completing a photocopy of this page and returning it to:

Rotakin Registrations
Home Office
Police Scientific Development Branch
Woodcock Hill
Sandridge
St Albans
Hertfordshire AL4 9HQ
Tel: 44[0] 1727 865051
Fax: 44[0] 1727 850642

I wish to register as a holder of Performance Testing CCTV v 1.00 and to be kept up to date with developments.

Please supply

☐ *the PSDB Operational Requirements Manual version 3.0*

☐ *the paper: 'Video & Image Quality'*

☐ *the paper: 'Operational Requirement Analysis - a new approach to effective security'*

Name.....

Position.....

Organisation.....

Address.....

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Telephone Number.....

Fax number .....

Date ..... *Signature* .....

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1 INTRODUCTION

1.1 Background

The Rotakin test target was designed to evaluate the performance of Closed Circuit Television (CCTV) security systems used in conjunction with Perimeter Intrusion Detection Systems (PIDS). Its development was described in the PSDB report 16/89, 'The Rotakin - a test target for CCTV security systems'. In 1989, the tests were described as follows:

"The Coverage Test will ensure that the cameras are theoretically capable of producing large enough images of intruders wherever they may be in the video detection zone. The test will show up any blind spots in the CCTV coverage. The Detection Efficiency test is to determine how well the observer will be able to see a suitably camouflaged intruder whatever the weather or lighting conditions. The combination of these two tests is aimed at demonstrating the limitations of the system in terms of detecting the specified type of intruders. Other tests can be made with the equipment to ensure that the equipment is correctly adjusted, but they are not a part of the basic procedures."

Since that time, many changes have occurred in the security industry, the demands and range of its customers and the type and complexity of the equipment used. The number of Rotakin test targets in use has grown. The Rotakin and the Operational Requirements concept, both developed in PSDB, are included in the CENELEC (European Standards Committee) CCTV Application Guidelines Standard EN 50132-7. The work has been drawn upon by other regulatory bodies, including NACOSS in their code of practice for installations and by SITO in their training material.

Rotakin has been used for a wide variety of tests other than those for which it was originally designed. For some of these Rotakin is very suitable; for others it is less so but, nevertheless, the only measuring device available. For tests other than the commissioning of systems associated with PIDS alarms, the use of the Rotakin should also be considered.

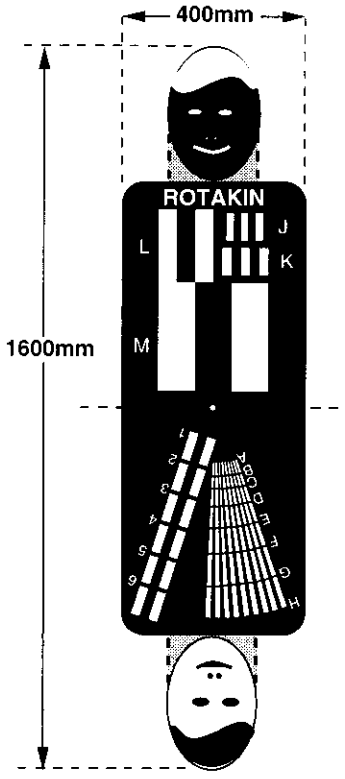
The purpose of this handbook is to provide guidance for the use of the Rotakin test target. The procedures described are based on assessing system coverage, image height and response time, as part of the PSDB Operational Requirement methodology.

1.2 The Rotakin CCTV Test Target

The Rotakin target, as illustrated in figure 1, is a panel simulating the silhouette of a man. The target area is a flat board 1.6 metres in overall length, 0.4 metres wide and matt black in colour. Each end of the panel is shaped to represent the outline of a human head. The target panel bears high contrast resolution bars and a resolution "wedge chart". These markings are incidental to those used in the basic test procedure but are provided for convenience. They may be used to adjust, assess and compare the performance of various items of CCTV or other imaging equipment.

For the part of the test procedure concerned with target detection (ie. usually human escapers or intruders), the Rotakin should be "clothed" in suitable material, usually disruptive pattern material (DPM) camouflage or black. When mounted on its stand, a motor can rotate the Rotakin test panel at approximately 25 rpm to simulate a moving target. When so mounted the top of the target panel is 1.8m above the ground.

FIGURE 1 ***The Rotakin CCTV test target and scale markings***



Rotakin Scale	mm/cycle on target	TV Lines/picture height for 100%R image
A	6,4	500
B	7,1	450
C	8,0	400
D	9,1	350
E	10,07	300
F	12,8	250
G	16,0	200
H	21,3	150
J	32,0	100
K	40,0	80
L	80,0	40
M	160,0	20

The markings on the Rotakin target indicate resolution in TV lines per picture height when the target fills the vertical picture, defined as the 100% Rotakin condition (100%R). The resolution of CCTV cameras and video tape recorders is frequently quoted in TV lines per picture height. The width of the target markings is defined in millimetres for a black and white cycle (mm/cycle), ie. the complete traverse of an adjacent black and white bar on the target. These measurements enable the dimensions of critical details, which need to be seen in a target, to be defined. The figures which correspond to the markings on the Rotakin are given in the table in figure 1.

1.3 The test methodology, Rotakin and ORs

Performance testing should be based on a written specification which reflects the needs of those who use and manage the system. All too often however, documentation defining or describing a site's security requirements lacks clarity and coherence. This makes it difficult for system designers to provide an optimised technical solution. This can lead to discrepancies between the expectations of system owners and the capabilities of their systems. These deficiencies can be revealed at an early stage by careful analysis and comprehensive testing, or later as a result of some unfortunate operational experience!

"Who should be the first to test your system, you or the criminal?"

Experience shows a clear need for a simple methodology that can:

- identify and document the purpose of employing CCTV in the security system
- be used to examine an existing system to determine the extent to which the system meets its requirements and to indicate areas for improvement
- lead directly to a simple, standard test to show reassurance that a system works
- be used as a prime tool for considering proposals for new systems
- help ensure that, for new systems, the true costs of meeting the need can be seen at the planning stage.

The methodology is aimed at ensuring that when testing is required, or is scheduled to be undertaken (ie, commissioning or routine tests), the results are quantitative and meaningful. The process documents the various demands on the system stakeholders to produce collectively what is referred to as an operational requirement (OR). The OR is prepared by answering questions set out in a table (figure 2). Each element of the table is capable of being measured or assessed and used to measure the extent to which the operational needs are met. A performance specification and test criteria can therefore be drawn directly from the OR checklist. The Rotakin test target provides the standard for some of the tests. Test results can be compared with the OR and decisions made about the next step.

Although ORs should be produced as part of the planning for new systems, they can and should also be produced for existing systems. In these cases, care must be taken to ensure that the table reflects the site's security needs and not merely the security offered by the existing system. The OR should be a "live" document. Indeed, whether for new or existing systems, the OR will need to be kept up to date by regular review because changes to the layout of the site, its use, the security status or resources could each have some impact.

1.4 Rotakin tests and OR checklists

The process of developing an operational requirement will:

- segment the problem according to the areas of the site to be viewed
- define image size according to the 'purpose of the observation' as given in box 3 of the OR checklist and the guideline figure relating to the purpose (see para.2.3 below)
- define the anticipated observer response time for the system to be effective, as given in box 13 of the OR.

The Rotakin may be used to assess each of these three key performance parameters:

- areas to be viewed in the pictures
- size of the images produced on the CCTV monitors
- anticipated minimum observer response time necessary for the system to be effective.

A Rotakin based test specification for either a commissioning test or for a routine system test may therefore be derived directly from OR checklists. The OR checklists also define test tolerances and other performance criteria which may be tested as required.

FIGURE 2 ***OR Checklist*** *- reproduced from CCTV Operational Requirements Manual version 3.0*

CCTV Operational Requirements	*'Check List'* *version 1.0* *Ref Code* *Type of Area*		
Describe the area of interest in relation to the marked Site Plan;			
1: Target to be Observed:	6: Result of a successful Response to the Activity:	11: What will the Observer do when the activity Occurs:	16: Stake-holders:
2: What Activity by the Target is of concern:	7: Who makes the Response:	12: How will Observer know when and where to look:	17: What Priority is assigned to this task:
3: Purpose of the Observation:	8: Time scale of the Response for it to be successful:	13: How quickly does the Observer need to act:	18: Likelihood of an Activity occurring and how often:
4: Picture Quality/Content factors needed to achieve success:	9: When is observation needed:	14: Who makes the observation on which the response is based:	19: How effectively does the task have to be done:
5: Spare	10: Conditions under which the System needs to be effective:	15: Where will the observations take place:	20: Benefits of doing the action over not doing it:

The 'areas to be covered' by the security system are marked up on a site plan and for each area defined on the plan a separate checklist is completed. Any important dimensions are added or made as separate notes. The 'purpose of observing' each area is then defined in checklist box 3. If any area is to be observed for more than one purpose then a separate checklist should be completed for each purpose in each area. This will allow different priorities to be applied and ensure that the relevant specifications and test procedures are applied.

Depending on the complexity of the system being studied, the first pass could be at a high level, stating only the broadest outlines of the requirement. Subsequent passes will penetrate deeper until each significant area and purpose has been fully defined. This may take several passes with the checklist table being further subdivided as the analysis becomes more detailed. These latter stages could define key factors to be included in the test specification and reference points for analysis of the test results. This might include identifying zones defining the alarmed areas, high risk areas, likely points of entry, potential weak points, etc. It is vital that the areas defined remain "problem" specific and do not become "camera" specific.

The initial checklists, ie, those completed at the first or first few passes, should be prepared independently by each interest group or stakeholder. This will help expose potential conflicts which can then be resolved as the analysis progresses.

Further information on ORs is available from the CCTV Operational Requirement Manual available from PSDB (see registration form).

1.5 Advantages of OR based Rotakin testing

Using the proposed methodology and conducting Rotakin tests will help to:

- demonstrate that a systematic approach has been applied to consideration of the site's security needs
- define an accurate and achievable OR for the system which can be endorsed by the management chain
- produce a performance specification which needs only two source documents: the OR and a site plan. The system will be tested against the performance specification
- ensure that system owner understands the capabilities and limitations of the system in meeting the defined OR
- demonstrate to the system owner (or his nominated representative) at the time of hand-over that the system is able to meet the defined OR
- provide an easily understood (and auditable) written record of the commissioning tests/checks
- ensure by routine measurements that the performance of the system is maintained. These measurements may be compared with the record made at the time of commissioning and, in the course of time, with those made at the time of the previous set of routine tests.

1.6 ORs in the life of CCTV Systems

The following are key stages in the procurement process:

- develop the Operational Requirement (OR)
- define the System's Performance Specification
- outline the test specification
- issue an Invitation To Tender to design the system, against the operational requirement and performance specification
- select and place a contract for the design that best meets the OR and the performance specification (Post contract negotiation may well be required to remove incompatibility between the OR and design)
- agree the designer's technical specification
- install the system
- commission the system against the test specification
- accept the system including test and analysis of results
- operate and maintain the system
- conduct routine auditing.

Each of these stages should make reference to the OR and the performance specification to ensure that the project remains on target.

2 ROTAKIN TEST SPECIFICATIONS

2.1 Rotakin test specification table

An outline test specification can be prepared from the set of OR checklists.

Task-area reference code	Rotakin image height as a percentage screen height (%R)	Observer response time (ORT)
as defined in OR checklist headers and box 3. (See para. 2.2 below.)	*based on the guideline figure appropriate to the 'purpose of the observation' given in OR checklist box 3. (See para. 2.3 below.)*	*in seconds/minutes etc. as defined in OR checklist box 13. (See para. 2.4 below.)*

The test conditions may be specified for the whole area or parts of it. These will be defined in checklist boxes 9 and 10.

2.2 Task area identification

Each area or volume should be clearly identified on the plan and, if necessary, described in a separate note. Each area to be tested should have its own unique reference code.

2.3 Image height (%R)

For each 'purpose' as defined in box 3 of the OR checklists (identification, recognition, detection, monitor), there is a PSDB guideline figure for picture content. The figure guidelines are given in terms of the minimum percentage of CCTV screen height occupied by the image of a standing man (equivalent to a Rotakin target 1.6 metres high). The term %R is used, eg, 100%R is an image of the Rotakin filling the screen height.

The PSDB guideline figures are as follows:

Monitor and Control..... not less than 5%R.

Detection ..... not less than 10%R.

Recognition..... not less than 50%R.

Identification..... not less than 120%R.

These figures are based on a 625 line CCIR standard TV system and assume that all the equipment is correctly adjusted and operated. Other figures may be specified as necessary, eg, to allow vehicle licence plates to be read. For further details see the OR Manual.

If the figures are varied this must be made clear in the specification and the test documentation.

The ability of the system to provide a suitable size of image anywhere in the area to be covered can be tested using the Rotakin. The guideline figures for image height assume that the size of the picture monitor screen, observer viewing distance and observation conditions do not themselves limit the system performance.

2.4 Observer response time (ORT)

The observer response time is included in the checklists in two ways. Box 13 gives the observer response time. This should include the time taken to identify the camera and monitor combination as well as to analyse the picture. The observer response time specification should state what constitutes a response so that it may be measured as part of the tests. It should be clear when timing should start and stop. A response time less than the agreed figure is a pass; a greater one is a failure.

Where the observer needs to carry out actions independently of the CCTV system under test, eg, opening a door or passing a message, the duration of these actions should be included in the overall system response time given in box 8. This additional time should not form part of the Rotakin commissioning test unless it is stated in the contract that full integration with other procedures is required and that this will be tested.

3 ROTAKIN TEST PROCEDURES

3.1 How much testing is needed?

The scale and therefore the cost of a test programme can vary dramatically, depending on its purpose and the phase in the life cycle of a system. Tests may be carried out as a spot check, part of a rolling programme or as a full test. The coverage and system response time tests described in this handbook do not preclude the use of any other tests considered to be necessary to judge the performance of a CCTV system. For instance the operator environment should be the subject of a separate ergonomic assessment. A task assessment should also be carried out to confirm that the operator's workload can be coped with.

3.1.2 Full test

These test all aspects of performance, throughout the system.

3.1.3 Partial test

These test some or all aspects of performance over specific parts of the system. This might follow maintenance, be in response to an incident or to specific conditions.

3.1.4 Rolling programme

This is where the whole system is tested, a bit at a time over a defined period.

3.1.5 Spot check

These are partial tests of the system, carried out at random, or to some pattern. This may be perhaps "worst case scenario" testing, as defined by the managers, test team or the operators. It may be used to confirm that previous tests have been carried out correctly. The spot check has the advantage of needing minimal resources.

3.2 Different types of system test

There are many reasons for performance testing: feasibility testing, design testing, setting up, evaluating, comparing, commissioning, routine testing, post maintenance checking and security auditing. In most cases, electrical and electronic testing should precede performance testing to confirm that individual items of equipment are operating correctly. Routine tests and security audits should not be relied upon to reveal underlying equipment failures.

3.2.2 Feasibility testing

This is a test carried out as part of the planning stage. Various options, including selection, placement and adjustment of equipment, are tried in order to see what can be achieved. This often involves the customer and his technical advisers in an attempt to establish whether or not the customer needs, as expressed in the OR, can be met. This form of test frequently uses a camera on a hoist or a camcorder to experiment with camera positioning. A recording may be made to demonstrate what might be achieved. The tests may be at typical locations on site, "worst case" locations or may cover the whole site.

3.2.3 Evaluating systems

These tests may be similar to those used in feasibility studies. The aim is to measure equipment performance against standards in a way that will allow meaningful comparison of results taken at different times and possibly places. In this way a database of results can be produced to inform equipment selection decisions.

3.2.4 Comparing systems

These tests compare the performance of one type of system with another, or of different technologies. The tests may not produce information which can be compared with other results taken at another time or place. The aim, however, of a comparison must be to make the range of test conditions as nearly the same for each of the tests on different equipment. For this reason they are frequently carried out with the systems under test placed side by side. It is important to record the test conditions as well as measuring the parameters being compared.

3.2.5 Design testing

This may in many respects be similar to the feasibility testing but based on a specification which has been drawn up from an operational requirement, that has itself perhaps been refined by the feasibility tests. This test may allow assessment of supplier's proposals.

3.2.6 Setting-up testing

This will be carried out by the supplier or technical consultant prior to the hand over. It will allow final adjustments to be made to the equipment. It is an opportunity to ensure that the commissioning test will be more of a formality.

3.2.7 Commissioning testing

This is a test of a system after it has been set up by the supplier. It aims to demonstrate to the customer the effectiveness of the system in meeting the operational requirement. It is essential that this test is comprehensive as the results should be used to confirm customer acceptance that the system is fit for operational use. Rectifying shortfalls should be the responsibility of the supplier. Acceptance of the system will pass responsibility for any remedial action to the customer.

3.2.8 Routine testing

The purpose of this is to ensure that the equipment is still functioning in accordance with the current operational requirement. It will either confirm that no significant performance changes have taken place or expose any shortfalls. It may include repetition of some or all of the commissioning tests, or a spot check based either on random selection or on some other means of determination.

3.2.9 Post maintenance checking

These will see that the system is reset to its normal condition and may include a check that cameras have been repositioned correctly. The results will be used to confirm acceptance by the customer that the system is ready for use.

3.2.10 Security auditing

Security auditing is normally associated with a review of the operational requirement to ensure that the system continues to comply with it. Changes to the OR will probably require further tests to determine the extent to which it can still be met.

3.3 The key Rotakin tests

Whatever the purpose of the testing programme, the aim of the Rotakin tests is always to determine whether or not the operator can see a target in the area protected by the security system. These are termed the Coverage and Detection tests.

3.4 Rotakin coverage testing

The purpose of this test is to determine whether or not the cameras cover the required area. That is to say, whether they are capable of providing images of acceptable size of intruders located in or near to the protected area, when viewed under specific conditions. Targets at long range can be too small to be seen and those close to, or to either side of the camera, can be out of sight. The width of the effective field of view must also be established and, particularly if a fence or building is included, the height.

The coverage test should aim to:

- confirm the area viewed in terms of coverage specified in the OR
- confirm the size of the image of the target
- show the existence and extent of any blind spots.

The results of these tests, along with the corresponding parameters in the OR should be marked on the CCTV site plan or recorded in some other way, eg, the numerical data could be tabulated.

3.4.2 Coverage test procedure

For each area defined in the OR, the Rotakin test target should be placed facing the camera at points within or near to the area to be protected. In some cases, the specification may call for coverage of all areas within x metres of the zones defined in the OR.

The Rotakin should normally be set vertically. Where appropriate, eg, at the near point to the camera, the test might also be carried out with the target panel horizontal at ground level, still facing the camera, to simulate a crawling man.

To pass the test the panel must be clearly visible to the observer when the view from the correct camera is displayed. The size of the image of the target displayed on the monitor should not be less than the minimum necessary to meet the purpose of the observation in that area, eg, 10% picture height for detection. To make the test quick and easy to conduct, it should be carried out in daylight, using the target panel of the Rotakin without the stand and without camouflage. The locations of the target and results of these tests should be marked on the site plan and or a test report form. The image size and the coverage, in particular, of any blind spots, can then be compared with the OR.

3.4.3 Coverage test locations

Some thought should be given to positioning of the test target so as to ensure that the limits of the system are fully explored as well as its average performance. It is particularly important to test where the target will be smallest or may not be in view at all.

Each additional test will add to the time taken and this will quickly multiply up if many tests are made in each area. The results of tests which do not provide new information need not be recorded. For instance, once the typical camera performance has been established many of the results may be assumed for similar cameras and their fields of view.

The whole perimeter of the areas defined in the OR should be tested to confirm visibility from one or more of the cameras. If the area is flat, small and regular in shape, then spot checks may be carried out at the corners of each area. Tests should be conducted at the points where the coverage of each camera crosses the boundary of the area or overlaps with another camera, so as to ensure that there is adequate overlap. The areas under the near points of coverage should also be checked.

If the areas are irregular, include uneven ground or obstructions, additional tests will be needed to ensure that there are no unreported blind spots. Additional tests may be required other than at ground level to cover walls, fences, roofs, ditches, etc.

Each test should be given a serial number to allow results observed in the control room to be identified with the test data recorded by the team on the ground.

3.4.4 Effectiveness of view

The 'effective field of view' from a camera is the useful view as displayed on the monitor. This may be reduced by blind spots caused by obstructions or areas which are poorly lit or by monitor overscan which is described below.

3.4.5 Monitor overscan

It is standard practice for TV monitors to be adjusted so that a fraction of the camera image is lost at each edge. The precise amount of this 'overscanning' can be up to 20% of the picture area. It may vary from monitor to monitor, changing with picture brightness or, as a result of operator adjustment, natural ageing of the monitor circuits or poor quality equipment. The blind area it produces can change without the operator being aware, possibly leaving undetermined gaps in the system coverage.

Overscan adjustment is an historical throwback to when equipment was less stable in performance and is not necessary if good quality equipment is used. Good monitors should be capable of internal adjustment to remove overscan although this may not be easy for some monitors. Unless otherwise agreed in the specification, tests should be carried out with monitors set to normal adjustment, ie, over- or under-scanned.

3.4.6 Adjustment of cameras

Weaknesses in the system can occur if cameras are not adjusted accurately. This can lead to inadequate coverage or images being out of focus. Key points in each camera view can be marked on a transparent overlay for the monitor screen,. The overlay for the correct camera can then be used as reference to check alignment at, say, the end of a maintenance visit, prior to accepting the camera back into service. A note might also be made of the expected image size and resolution marking (ie, the relevant letter) to be seen when the Rotakin target is placed at a particular location.

Focus checks should take place under the same lighting conditions as the reference test. This is particularly important with systems required to operate under low light or with infrared illumination. Reference images can also be made using a video printer.

3.5 Rotakin detection testing

3.5.1 Response testing scale and acceptability criteria

The detection test poses the question: can the observer easily pick out a suitably clothed target over the range of conditions defined in the OR? Tests are carried out by placing a suitably clothed Rotakin, without the operator's knowledge, at locations in the areas under test, as defined in the OR. The operator is then alerted and the time he takes to find the

target is measured. For fixed cameras, this could mean the time taken from the initiation of an alarm signal to the point where the operator has correctly acknowledged the presence and location of the target.

Testing PTZ cameras is more complex. The time could be taken from the initiation of an alarm signal to the point where the relevant camera has moved to an automatic pre-set position and/or the operator has driven the correct camera, including zoom and focus, and has correctly acknowledged the presence and location of the target.

The results of each detection test are assessed according to the following scale:

grade 3 - target easily seen; it would be immediately obvious and no mistake possible

grade 2 - fairly easily seen; the target needs to be searched for but would not be missed and is found during the allowed response time

grade 1 - difficult to see; is only found after a careful and lengthy search that exceeds the allowed response time

grade 0 - target not seen at all.

Timing the response of observers from the moment of an intruder alarm to their rejection or acceptance of the alarm is a significant measure of system performance. The acceptable response time depends on the delay expected to be provided by the barrier associated with the alarm system and should be included in the system specification. This timing is the recommended method of setting a threshold for distinguishing between response grades 1 and 2. Obviously, the results will be, to some extent, operator dependent.

Although, ideally, all target detection scores will be grade 3, grade 2 is acceptable for effective CCTV system operation. Where test results are not to specification the contractor should rectify the problem. In some cases, system managers might be able to relax the OR based on suitable alternative security measures or a review of the risk. When a commissioning or post maintenance hand over test is being carried out, acceptable levels of performance must have been defined to a sufficient level of detail in the contract documents for them to have any value in the event of a dispute.

3.5.2 False and nuisance alarms

Tests should be carried out without Rotakin targets and using false targets to see how long the operator takes to declare a false or nuisance alarm with confidence. Nuisance targets might include items such as a plastic dustbin, dustbin bag, football, etc. The following scoring scale is suggested:

grade 2 - when 'no target' condition is declared correctly within the OR response time

grade 1 - when 'no target' condition is declared correctly outside the response time

grade 0 - target declared when no target is present.

3.5.3 Setting the response time

The acceptable response time should be specified by the client. It should be practical and it may be influenced strongly by a range of factors including:

- the delay provided by the fence, ie, the time taken to breach it
- the area/volume viewed by the camera
- the number of false targets (eg, people who are entitled to be present in the area) which need to be recognised and accepted as present
- the number of screens to be searched
- the need to manually select cameras
- the number of different pictures to be examined, following the alarm, to ensure that the whole alarmed area has been checked
- the need to manipulate any of the cameras with a remote control unit in order to search an area.

Through careful design of the lighting system and camera siting, together with good control room design, large fixed camera systems with accurate and reliable operator cueing can reliably achieve response times as low as one or two seconds. With fully functional cameras (ie, pan tilt zoom, PTZ, cameras) the response time may be 30 seconds or more, depending on pan, zoom and focus speed and the area to be searched. For systems with barriers providing a very long delay for an intruder, a longer search time might be allowed. For one with a comparatively short delay in the barrier any time lost during the search might allow an intruder to pass unobserved through the detection and search zone. Where the required detection times cannot be reliably obtained with 10%R targets then a larger target percentage may need to be specified.

If there is any doubt, tests should be carried out prior to the response time being set to establish a reasonable norm. This should be part of the development of the OR phase of drawing up the specification and will depend not only on the barrier delay, but also on the response time of a guard force or other emergency response team.

For installations where a high degree of protection is required, or where the results are in doubt, it is recommended that these tests be repeated using different observers. If the results are different, then the worst result, ie, the longest response time, may indicate the expected worst case performance level. Other causes should be investigated to ensure, for instance, that the test conditions are repeatable and that failures are not due to uncorrected eyesight!

3.5.4 PTZ response time test procedure

From the OR checklist and knowledge of the site, a location should be chosen where the system response time is to be measured. If, operationally, the camera covering that area may be parked anywhere, the test should be started with the camera set to one end of its pan range. If a camera has a pre-set or datum condition, the time to locate a target from this position should be the system response time. A suitably clothed Rotakin should be placed without the operator's knowledge at the agreed position. An alarm signal should then be initiated and the time should be noted for the operator to drive the camera and lens to a position where the presence and location of the target is correctly determined. This test should be initiated with the lens set at minimum focal length and the camera in its normal rest condition.

If tilting of the cameras is necessary to search the whole area, this may dramatically increase the response time. It should not be assumed that targets will be visible to the operator if the pan speed is too fast, the lighting poor or the scene busy. A slower pan or modified search pattern may be required to improve the probability of detecting a target.

These measurements of response time will provide the client with a realistic idea of the operator response to an alarm signal in each zone.

3.5.5 Observer cueing and prompting

It will be necessary to decide the method of observer prompting to be used during the tests. This may require technical solutions such as adding a trip mechanism to the alarm monitoring and control system. This will allow an alarm sector to be triggered or more importantly to be held off while the target is set up.

In some systems, when the alarm is triggered, the observer is prompted to look at each of a number of camera pictures providing coverage of the alarmed zone. The specification may call, for instance, for both sides of a barrier to be viewed and searched. The response time should include selection and search of all of these pictures.

Sample tests to establish times to find targets using, eg, an unprompted routine patrol are often useful experience.

3.5.6 Detection test locations

The Security Manager with his advisers should define the exact test points using his knowledge of likely attack points and likely weaknesses. It must be remembered that these tests and the results may represent a key to unlock a security system. They must, therefore, be treated as sensitive information. For a commissioning test programme, the contractor should be notified in advance of the conducting of the tests but the right should be reserved by the client to carry out further tests if necessary. The more notice given to the contractor the more likely it is that the client's expectations will be understood and taken into account in the design. The contractor should understand that tests will be carried out under worst case conditions for size and contrast, where the lighting is poor, the scene is cluttered or busy or where the background provides little contrast for targets. This gives the opportunity to either re-design in order to produce a larger target or to advise on changes to the lighting in order to raise the contrast of the target.

The choice of location of the Rotakin target for the detection tests will obviously be site specific. As a guide, the target should be deployed in areas consistent with the possible locations of an intruder. The location should take account of both good viewing conditions with large targets to obtain a test reference point as well as worst case viewing conditions. The geography of the site might affect the response teams' access, delaying them and putting more pressure on the observer for quick target identification.

3.5.7 Impact of lighting on the detection test

Large, high contrast, moving targets are much easier to detect quickly than small, low contrast, stationary ones. The performance of 'monitoring' or 'detection' tasks will be more consistent and predictable if the target is silhouetted (back lit) as the contrast will be less dependent on the clothing of the target, a performance factor generally out of the system designer's control. The converse requirement exists for tasks where internal detail of the target is to be made out by the observer and so front lighting is then essential. 'Recognition' or 'identification' of targets are examples. This further underlines the need for clear thinking about the OR in relation to the purpose of the images.

Tests should be carried out under the full range of expected operational lighting conditions. If a system may be required to work with a certain degree of degradation of the lighting system, eg, every other light inoperative, or emergency lighting, then tests should take this into account. A comprehensive test would include full daylight, darkness with all normal lighting switched on and difficult conditions such as sunrise and sunset. Consideration should also be given to the effects of potential sources of stray lighting such as street furniture, reflections from standing water and vehicles. The impact of occasional lighting such as vehicle flashing lights during an emergency or Christmas illuminations, should be considered.

Some of these tests will be more demanding than others and time should not be wasted carrying out tests which are clearly going to be a failure or a pass. Decisions to omit tests must be noted in the test results.

3.5.8 Rotakin target camouflage

Suitable material should be attached to the Rotakin to take account of local conditions and what intruders might be expected to wear. Materials for Rotakin commissioning detection tests should be specified by the customer in the tender documents. It may be necessary to try a variety of camouflage materials in order to test fully the system performance. The standard material for the test should be disruptive pattern material, DPM, camouflage. Other colours which should be considered are black green and tan. Test results should be noted for each type of clothing used.

3.5.9 Tests with moving targets

An effective security system must be capable of performing well with both moving and stationary targets. The ability to explore this vital aspect of CCTV system performance is a primary function of the Rotakin test target. Some cameras will perform less well, others may allow a moving target to be more easily seen but perhaps only under certain conditions. Detection tests should, therefore, be carried out with the target moving as well as with it stationary. The results for both sets of tests, using the grading scheme given in 3.5.1, should be noted with the worst determining the limit of performance, unless otherwise stated in the specification. For instance, in an area where it would be unlikely for an intruder to remain stationary for any length of time a pass mark may be acceptable only with the Rotakin moving.

The Rotakin target carries a pair of parallel lines whose axis of symmetry passes through the axis of rotation. The lines are 20mm wide and 20mm apart and are broken every 70mm along their length using the axis of rotation as the reference. These markings allow the effect of variable exposure time (electronically or mechanically shuttered) on moving image quality to be observed.

3.6 Site-specific commissioning test procedures

Tests may be carried out in a variety of ways depending on the context. If a detailed setting up test has been carried out, then the customer may be content to carry out spot checks to confirm the setting up. If no prior testing has been carried out, then a full test will probably be needed. In either case the procedure is similar. It is assumed in the operational performance testing described in this section that electrical and electronic performance has been checked and the results recorded.

The knowledge and experience of the test team will substantially affect the time taken to carry out a test programme. It is strongly recommended that teams gain experience by testing existing systems. The test team should consider:

- selecting two adjacent areas to test on the basis of convenience, typicality and size
- testing those areas
- thoroughly reviewing the test procedure and results with the system assessors
- agreeing the remainder of the test procedure especially the number of tests carried out per camera and the method of presentation of the results
- completing the test programme
- analysing the results and recommending action.

3.6.2 Duration of the test

The duration of the test will depend on the size of the installation, the extent and detail of the testing, experience of the test team and whether or not it is the first time the installation has been tested. A small system might take an afternoon and an evening to examine. For a very large system it may take several days or even weeks to test every camera thoroughly. Worst case testing will have to wait until appropriate conditions are experienced.

It can take a long time to thoroughly test the first area examined. However, subsequent areas may be dealt with more quickly using the earlier experience. With an inexperienced team, or when on a new site, it may be worth while testing one typical area and then reviewing the results before moving on to complete the full test. Alternatively, the test might be shortened by a quick test of all the areas to find weak spots which must be fully tested, or strong areas which do not require further testing. The initial results might show the quality of the installation to be so high, or low, that further testing is superfluous. Therefore, an initial test programme should not be too ambitious.

3.6.3 Test conditions

Before carrying out commissioning tests, the whole system should be set up correctly. To provide a performance benchmark, tests should be carried out under conditions that most closely reflect normal everyday use. As far as possible, the operator or observer should occupy his usual position carrying out normal duties. All components of the system should be in their "normal" mode. For instance, cameras which are adjustable should be in their rest position with zoom, focus and iris in whatever is the normal pre-set condition; monitors should be adjusted to their normal settings. Any 'adjustment' to the system performance, even a simple task such as cleaning the monitor screens, which is not part of normal or prescribed procedure, may significantly affect the result of the test. Any factors which might, during normal operation, have an impact on the system performance should be noted. For example, the guard might have to leave the picture display monitors unattended in order to fulfil other duties; the monitor controls might be adjusted to suit particular conditions, eg, the effect of stray lights from buildings, traffic or sunlight entering the control room. The fact that the observers are alerted to the test will undoubtedly affect the results. Other important parameters will be the weather and the time of year of the test. If the weather is good, allowance will have to be made for loss of performance under poor conditions. The time of year will affect the angle and direction of sunlight. This might make observations difficult during critical periods of high activity such as the rush hour.

Checks should also be carried out when response might be slowest. This might be because of equipment complexity making certain tasks complex or difficult. It might be when the observer work load is at a peak or pictures are very busy, during rush hours or during an emergency such as a fire (this could be checked during a fire drill), or when the lighting is at its worst.

These may lead to a programme of tests to check performance under specific (unusual) conditions, eg, when visibility is poor, in rain or fog, when there are puddles on the ground, or snow, etc. Special test conditions should be noted in boxes 9 and 10 of the OR checklist. It may be necessary to wait for certain weather conditions, fog, snow etc. to obtain a full knowledge of system performance under adverse weather conditions. Conversely, it may simply be impractical to do so and allowances may have to be made for that.

3.6.4 Testing a 'live' system

For various reasons it may be impractical to meet all of the test conditions. For example, in a live system it is assumed that the PIDS system cannot be disabled without the knowledge of the guards. Placing the target in a detection zone without tripping the alarm would then be impossible. In these circumstances, the observer's view of the monitor could be temporarily obstructed while the target is deployed.

3.7 Rotakin test results tables

Having decided the type and extent of the tests to be carried out, test procedure and results table can be drawn up based on the test specification table. The table and supporting test recording system must allow for all of the results that will be needed for the performance analysis. General statements such as test conditions might be made at the head of the test sheet or included in the columns. Any special test conditions to be taken into consideration during the test will have been specified in boxes 9 and 10 of the OR checklist.

Task area reference code	Rotakin height	Observer response time (ORT)	Observer response score	Is whole area covered?	Notes & comments
and test number noted on site plan	*in %R or 'not displayed'*	*in seconds & how observer is cued*	*grade: 3 to 0 & comments: very clear, clear, indistinct, not discernible*	*yes/no show details on plan*	*night/day and lighting, weather, Rotakin clothing, moving or stationary*

If there is a requirement for coverage of the same area for more than one purpose then there must be a separate test row for each.

Where the CCTV is used to verify an alarm state from a PIDS, each zone will need to be identified to ensure that all are tested.

3.8 Additional tests and results

Any specific 'activities by targets' that are to be observed will be defined in box 2 of the OR checklists. The relevant tests should be included to ensure that these requirements can be met. Where this requires a particular size of object to be resolved the relevant markings on the Rotakin panel may be used to assess likely performance. Where only operational experience will allow the performance to be checked these items should remain in the test programme until confirmed.

Tests for any special picture quality or content factors, as defined in box 4 of the checklists may be added to the programme and results table. Where these call for a specific level of detail to be seen in the images, the resolution markings on the Rotakin target panel may be used to confirm performance. As individual results obtained in this way can be affected by many factors, they should be treated with great care. Tests based on comparisons of results from similar equipment or against a previous benchmark can be more reliable. They can be used to identify under-performing equipment either during set up, commissioning or maintenance.

Where box 17 indicates particular priorities the system should be checked to ensure that automatic systems comply.

Where box 18 indicates a particular level of activity, it may be necessary to test at that level in order to ensure that the system will not be over-loaded or under-loaded. In the latter case boredom or unfamiliarity with the procedure through lack of practice may significantly affect observer response times.

When assessing the results for a turnkey system, the time taken by the operator to complete the actions identified in box 11 should be added to the measured target acquisition time to show the observer total response time.

4 PREPARATION FOR TESTING

Preparation and a systematic approach should ensure that the test is conducted efficiently, effectively and in the minimum necessary time. The test team should be well briefed, suitably equipped and in possession of relevant literature and data on the system to be assessed. It is particularly important that the test team should have a copy of the Operational Requirement (OR) and/or Performance Specification for the system. These documents will specify what the system is intended to do and will be accompanied by a good site plan.

4.2 CCTV security system information folder

Ideally, every security system should have a consolidated volume of informative documentation, or set of manuals, written in a standard format. All the documentation and records pertaining to the CCTV element of the system could be held in one section or manual. We shall refer to this as a CCTV Information Folder.

4.2.2 Information folder contents

A CCTV Information Folder might include the following:

- **Operational Requirement**. The OR for the system, preferably a set of OR checklists dated and signed as being accepted by the establishment's responsible senior official.
- **Performance Specification**. A Performance Specification based on the OR checklists.
- **CCTV Site Plan**. See later paragraph.
- **Camera Plans**. See later paragraph.

- **System Diagram**. This should show how the elements of the system are connected and where to connect an external video recorder and monitor for test purposes, so that they do not alter the system performance or compromise security during the test.

- **Equipment Inventory**. An inventory of the system equipment which specifies serial numbers and any identification marks and lists camera and lens data including zoom ratios (to check the expected fields of view).

- **Literature**. Manufacturers' literature and handbooks.

- **Test Results**. The results from any previous tests.

- **System Notes**. A written record of points of interest or note pertaining to the system, either recorded before a test or as a result of a test.

- **Test Aids**. Any locally produced test aids or test equipment (eg, acetate view-foils for the CCTV monitors which mark reference points for camera re-alignment).

- **Installation Record**. A chronological record of changes to the operational requirement, camera fields of view or equipment, and of tests conducted on the system.

- **Maintenance Log**. A chronological record of maintenance activities which may affect system performance, eg, lighting adjustments, changes to the vegetation.

- **Guidance Notes**. Specific site-related guidance, if required, recording any suitable methods for carrying out a specific test when a common method is not appropriate or possible.

- **Miscellaneous**. Any other relevant information.

At the start of a Commissioning test only the OR, performance specification and the CCTV site plan are necessary as many of the other records should be products of the commissioning test and hand over. (The installation contract should have ensured that the contractor provides much of the required documentation).

4.2.3 CCTV site plan

A CCTV Site Plan should exist for each site. It should be marked up with the areas intended to be covered by the camera system as defined in the OR checklists, the camera locations, the security barrier and, if applicable, the sterile zone under camera surveillance. Task-areas reference codes should be marked as given in the test specification and results tables.

A CCTV Site Plan should provide a reasonable guide to the fields of view of each camera, the common overlapping areas of coverage, any known blind spots and, if possible, reference lines (as discussed under Camera Plans below). If the existing site plan does not provide this information the test team should produce such a plan as part of their report and for the site's CCTV Information Folder. All the information marked on the site plan will be subject to confirmation during the test team's assessment.

4.2.4 Camera plans

Apart from the CCTV system site plan, it is worth producing individual camera plans, marked-up prints of monitor pictures or, at the very least, written notes to show, or explain, each camera's horizontal and vertical fields of view. In addition, lines, or more

specifically arcs, should be marked, or noted in writing, to indicate where a target of known size (such as the 1.6m tall Rotakin standard target) is expected to occupy a specific percentage of the camera monitor's picture height. If pan-tilt-zoom (PTZ) cameras are employed in the system, these reference marks should be made for minimum and maximum zoom, or some other form of logical reference markings. To be able to detect the presence of a human target reliably, the system should be able to produce a picture of the Rotakin target as a minimum of 10% of picture height anywhere in the area of interest. Performance testing should aim to confirm that the area of interest is covered effectively and not merely confirm the field of view of the cameras!

4.3 Target range and field of view tables

The following tables provide examples of information that may be used to establish the area covered by each camera. The figures given are not precise and allowance should be made for monitor overscan, camera height, look down angle and the slope of the ground. Other figures can be derived using a CCTV lens range calculator.

4.3.2 Maximum target range for given image height

Imager size: 1/2"	Maximum range in metres for an image of height			
Lens focal length in mm	5%R	10%R	50%R	120%R
3.5	23.5	12	2.4	0.95
8.5	56	28	5.7	2.3
12.5	84	42	8.4	3.4
25	168	84	16.8	6.8
50	336	168	33.6	13.6

Imager size: 2/3"	Maximum range in metres for an image of height			
Lens focal length in mm	5%R	10%R	50%R	120%R
3.5	17	8.5	1.7	0.7
8.5	42	21	4.2	1.7
12.5	60	30	6	2.5
25	120	60	12	5
50	240	120	24	10

4.3.3 Angle of view

Figures 3a and 3b are 'protractors' showing the horizontal angle of view for a sample range of lens sizes and for 1/2" and 2/3" imager sizes. Photocopying the protractors onto a transparency will produce overlays which may be used with a scale plan and rule to assess the coverage of each camera.

FIGURE 3a ***Protractor overlay for 1/2" imager horizontal fields of view***

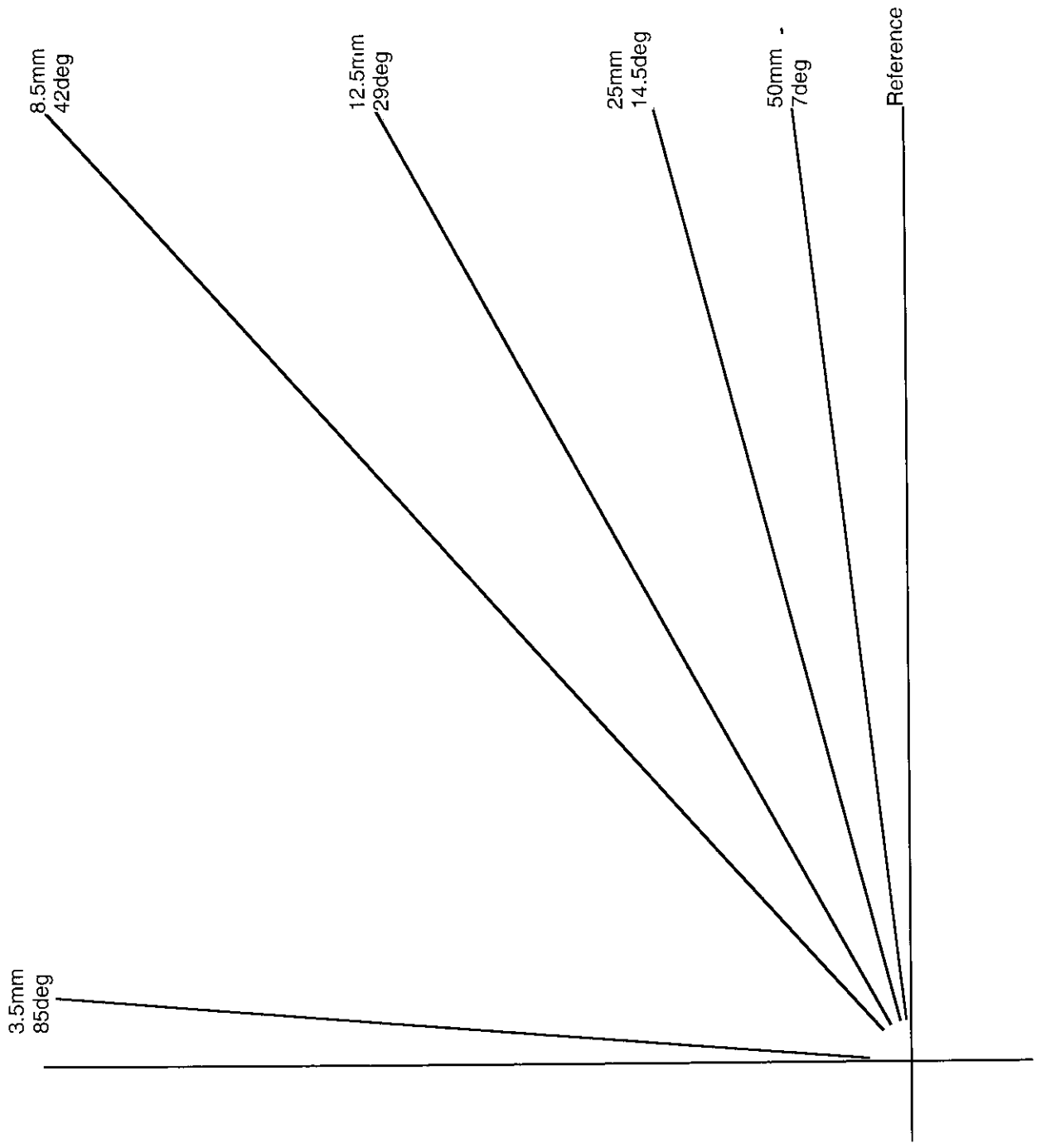
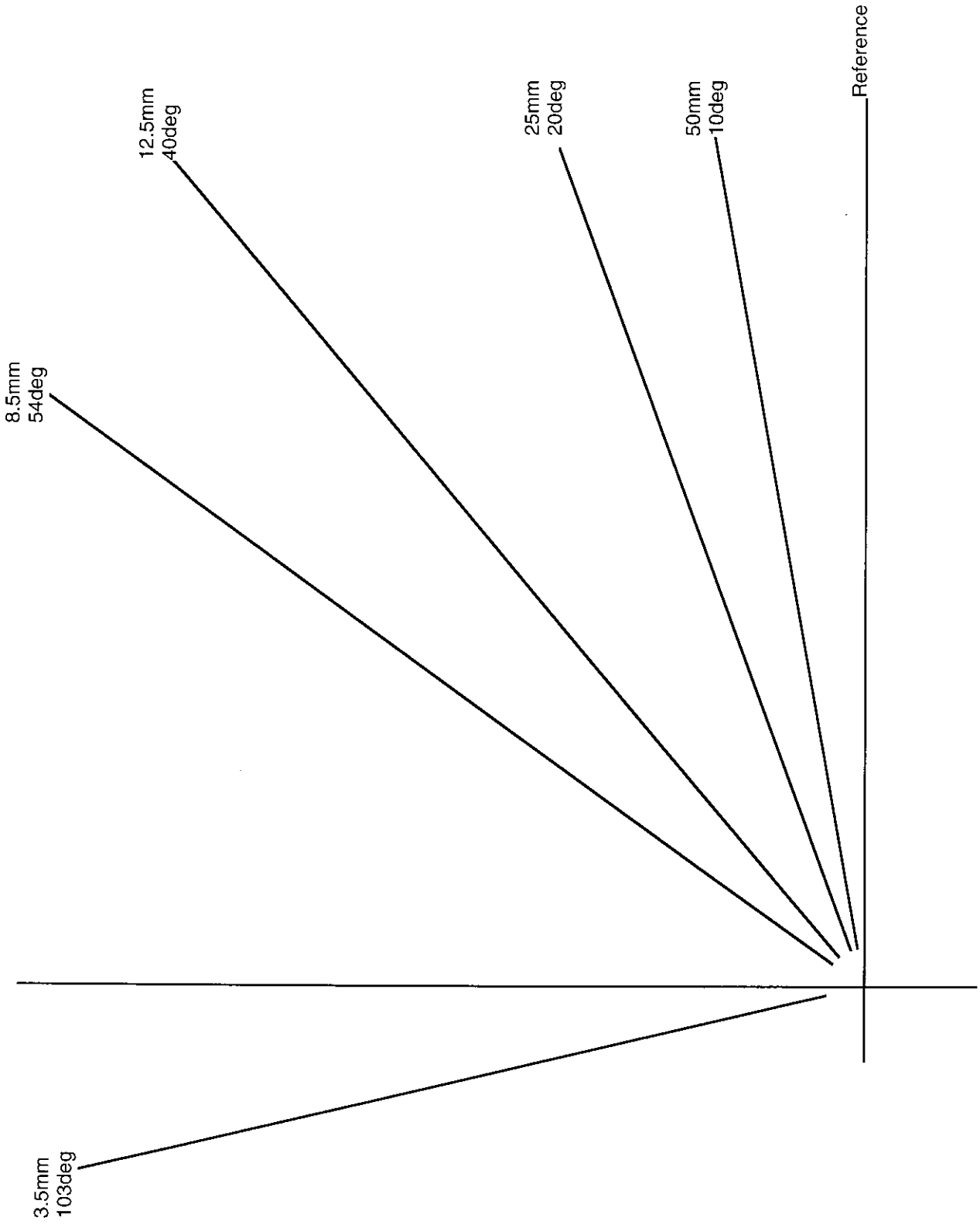


FIGURE 3b ***Protractor overlay for 2/3" imager horizontal fields of view***



Imager size 1/2"

Lens focal length in mm	Vertical angle of view	Horizontal angle of view
3.5	69	85
8.5	32	42
12.5	22	29
25	11	14.5
50	5.5	7

Imager size 2/3"

Lens focal length in mm	Vertical angle of view	Horizontal angle of view
3.5	86	103
8.5	42	54
12.5	30	40
25	15	20
50	7.5	10

4.4 Test team

Test team composition

The composition of the test team should be established. Even for a small site 2 people will be required to conduct a test. At least one will be needed in the room containing the CCTV monitors and another to walk the perimeter and conduct the tests. The assistance of the system "observers" (usually security guards or control room staff) will be required. If this is likely to interfere with their routine work, then an additional test team member, preferably an experienced observer, will be required.

Box 14 of the OR checklist will define 'who will make the observations' when the system is operational. This may define special skills or training, factors which should be considered when selecting the test observer. On some sites only properly trained and qualified staff are permitted to enter certain areas.

Although one person could deploy the test equipment, two people will do the job far more easily, particularly if the test is long or obstacles have to be negotiated. Therefore, most test teams will normally require a minimum of four persons. If the system is large, additional test team members can share the load, perhaps using several test targets to speed up the test.

4.4.2 Test team tasks

The test team should know what they are expected to do. They may have been told that, as part of an overall security audit, their task is to: "Evaluate and record the performance of the CCTV elements of the perimeter security system in the daytime and at night". For the following description we have assumed that OR checklists, Performance Specification and a Test Procedure exist, and the test team's task is simply to carry out the test procedure to see if the system satisfies the OR/Performance Specification.

There can be a great deal to do even to conduct a simple test. The following are typical roles of team members:

The field test team:

- Deploy the Rotakin target or not.
- Keep records of test locations (serials marked on site plan).
- Trigger alarms for detection tests (unless this can be achieved electronically).
- Note the time of the test for tying results together later.
- Pass relevant information on weather, lighting, etc. to the test recorder.

The observer being used for a detection test:

- Receive the prompt to start search.
- Carry out the search.
- Announce the result of the search.

The test recorder:

- Maintain a checklist of actions required to complete the test.
- Keep notes including: test serial, date and time, conditions of test (eg, weather).
- Time observer responses.
- Record observer results.
- Video record images presented to observer (with time and date reference if possible) and an audio record if required.
- Record observer activity (if such a record is to be made).
- Confirm that the tests are carried out in accordance with the procedure, including ensuring that the appropriate (ie, usual) size of screen and viewing distance is maintained and that no improper observer prompts are allowed.

If persons other than those involved directly in the testing are present they must be "managed" in order to ensure that they do not materially affect the test results.

4.5 Equipment for the tests

Apart from the site's CCTV Information Folder, or whatever information is available (at the very least a CCTV site plan marked up with the expected area of coverage), the test team should have everything else they are going to require. This could include the following items:

- **Identification.** Means of identifying each member of the team that will satisfy the requirements of the site being visited.

- **Test Targets**. A Rotakin test target as described and illustrated in the introduction to this handbook. It should have appropriate camouflage or other specified clothing. There should be sufficient fully charged batteries for the Rotakin motor if dynamic testing is required.

- **Ground Markers**. A minimum of 2 objects to place as reference points in the camera fields of view. Traffic cones with a reflective stripe or ranging poles are suitable.

- **Distance Measuring equipment**. A tape-measure (suggest 50 metre) and ruler.

- **Information Sheets and Notebook**. The test procedure and test recording sheets contained in waterproof plastic sleeves together with insoluble ink pens, and a waterproof notebook or blank sheets in waterproof sleeves. A clip board may be useful.

- **Test Aids**. Blank overhead transparency sheets to place on the monitor pictures (for making reference marks and ease of measuring the curved monitor screens). An opaque sheet of sufficient size to cover-up a monitor for the "Detection" tests.

- **Stop Watch**. A stop watch to record "Response Times".

- **Adequate communications**. A two-way means of speech communication between the observer in the control room and the target movers at the test site is essential if the test is to be carried out quickly and accurately.

- **Video recorder and monitor**. A video cassette recorder (VCR) and reference monitor (see paragraphs 6.7 & 6.8 below), and sufficient tapes to record the results. A camcorder and microphone could be useful if the observer activity is to be recorded.

- **A light meter**. But only if the test team has been briefed and trained to conduct light level tests.

- **Protective clothing**. Suitable clothing and footwear.

- **A torch**. (A head-lamp may be most suitable) For general use - and in case of unexpected disruptions to the site's lighting supply on a dark night!

- **Site specific items.** Passes, keys, etc.

4.6 Contact with site personnel

In preparing for the test, it may be useful to arrange for a free room to be available to the test team where they can write reports and store their outdoor clothing and equipment. It is vital that any health and safety requirements are met and someone with suitable knowledge of local hazards is available to advise the test team. At some sites a briefing, such as a safety induction course, may need to be arranged and clearance to use electrical equipment may also be required. The availability of a site vehicle and a driver familiar with the site may be an advantage so as to minimise the time taken conducting tests on a site with a long perimeter. This may be especially important for night time tests or in poor weather.

The purpose and nature of the tests should be fully explained to the relevant person(s) in authority, and to those site staff, such as control room personnel and security guards, whose co-operation will be needed and who may be required to take part in some of the

tests. A decision should be made as to whether the observers will be as found or whether members of the test team will be designated. It may be preferable to compare the results of more than one observer and note any significant differences.

It can be particularly valuable to establish a good rapport with those personnel who are required to view the CCTV monitors as they may often be able to provide valuable criticisms or comments. These may reveal limitations or unintentional advantages of the system which are worthy of inclusion in the test report and which might be suitably recorded as system notes in the CCTV Information Folder.

Concern may exist on the site about the motives behind tests made on systems in operational use. The initial views of management or staff can be strongly polarised either that 'everything is wrong with the system', usually following an incident, or that 'there is nothing wrong with our system', a natural enough view if they believe that they might be held responsible for any shortcomings. Staff should be reassured that the problems being tested for are technical and are commonplace. Experience has shown that suspicions are rapidly dispelled once the tests have started and the benefits to the users are perceived; but "breaking the ice" is vital if the tests are to be of maximum benefit. It is essential that no criticism be made of the operators and that it is made clear that the test is intended to help them by providing them with tools which work. Frequently the first test is an educational experience for all concerned!

4.7 Familiarisation with the test procedure

The test team staff should familiarise themselves with the test equipment and the procedures before the test begins. A sample test should be conducted on one of the cameras of the system to be tested. This camera should be chosen on the basis of ease of access to the area it covers and, if possible, in a quiet area. Local physical or operational considerations may dictate the way in which tests are carried out but it is recommended that a coverage test be made first, followed by the detection efficiency assessment. Experiments can be made at this time with different types of clothing or camouflage, in order to see which presents the most appropriate or severe test, or to establish whether or not different materials need to be tested. This should be stated in the contract if a commissioning test is being carried out.

4.8 Identifying the system

Before proceeding around the site, the testers should commence in the room containing the CCTV monitors and establish how the cameras are referred to; this will invariably be by location and/or number (ie, sub-site A, cameras 1 to 20). On the CCTV Site Plan they should confirm or mark the position and reference numbers of all the cameras and, if possible, give a rough indication of the apparent fields of view as seen by that monitor which is normally used. This should identify weak spots, etc. Unless otherwise stated in the contract commissioning tests should be carried out at the operational monitor position so that the full system is tested.

5 TESTING

The test observations should be carried out in the location(s) identified in box 15 of the OR checklist.

A coverage test should normally be conducted first, so as to assess whether there are any gaps in the coverage and whether the target is within the specification for image size. The detection tests can then be carried out safe in the knowledge that the target will be in view.

The location of each test should be marked on the site plan and the results recorded so that the test could be repeated if necessary. A selection of the tests may be repeated under a variety of weather and lighting conditions to determine likely changes in performance under adverse conditions.

5.2 Coverage tests

A simple coverage test can be conducted by having someone walk around the site while their progress is monitored on the CCTV system. Blind spots and areas of overlap should then be apparent as should the image size at the extreme ranges in the camera fields of view. The extremes of each camera's field of view can be established using traffic cones or similar objects. These can be placed at a suitable distance from the camera with one at the far right and one at the far left of the field of view so that the right and left extremities of the horizontal field of view are definable as lines running from the camera through the cones. The breadth of any blind ground immediately under the camera can be determined by placing the cones at a point where they just enter the picture.

5.3 Detection tests

Detection tests, or visibility checks, will generally be carried out at the extremes of range from each camera in each area under test and where poor lighting and/or poor focus produces low contrast targets. One or two 'worst' locations as regards visibility under worst illumination conditions, should be chosen from knowledge gained during the coverage tests. The clothed or camouflaged Rotakin should be placed at each of the worst positions in turn while detection tests are made with stationary and moving targets. Target visibility should be a minimum of grade 2 unless otherwise specified.

While these are tests of the installation and not a competition amongst the observers to see who can return the highest score, reasons for markedly different results should be examined, if possible during the tests, and reported. The use of independent 'expert' testers may increase the dependability of results.

6 RECORDING THE RESULTS

The tests will produce information and numerical data which will need to be recorded for subsequent analysis. Completed test sheets, video recordings and video prints will also form the basis of the maintenance log.

As well as completing the test results table, notes should be kept of reasons for unsatisfactory test results, additional tests to be carried out later and factors which influenced the choice of location for a test.

During the test programme some points of special note may come to light, such as blind spots and specific test locations. These should be noted on the Site Plan.

6.2 Image height

The guideline minimum image height for each type of observation category as defined in box 3 of the OR checklists are given in para. 2.3 above. The figures given there are based on a 625 line CCIR standard TV system and assume that all of the equipment is correctly adjusted and operated. The guideline figures are given in terms of the minimum percentage of CCTV screen height occupied by the image of a standing man.

The record of the test results might show whether the guideline figure has been met, on a pass/fail basis, or whether the image size has been measured and recorded. It would be helpful if a note could be made saying whether images are considered larger than necessary, acceptable or not large enough. This will help to determine whether, for particular locations, the 10% figure is correct. PSDB would welcome information about these results to inform future research.

From the equipment inventory the imager size and lens focal length can be determined. This information can be used in conjunction with a lens calculator to establish the maximum theoretical range at which the target should not be less than 10% picture height. Examples are given in the section 'target range and field of view table'. If the camera is mounted less than 5 metres above flat ground the error in range distance, found by measuring along the ground, is small. For cameras mounted higher up or for targets close to the camera the foreshortening effect should be taken into account.

6.2.2 Measuring image height from the screen

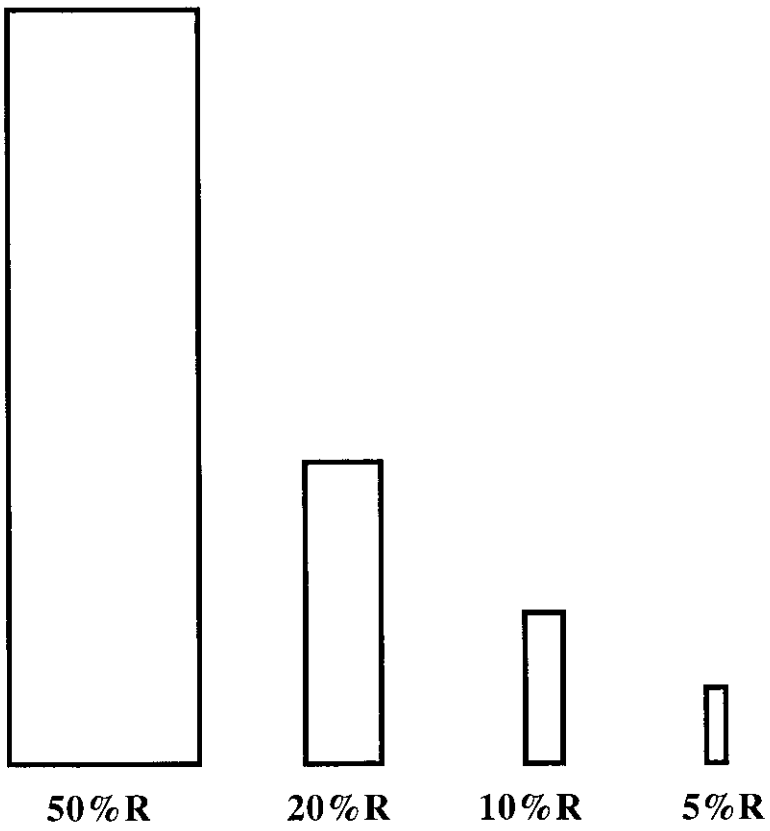
Sheets of overhead transparency film, with suitable sized boxes drawn or printed on them, make measurement of image size quite easy. The boxes should cover a range of, say, 5, 10, 20 and 50 per cent of the displayed picture height. An example which may be used to produce an overlay suitable for a 200mm (12") high screen is shown in figure 4. Boxes corresponding to the size of the monitor should be used. The height of the visible screen should be measured. If the monitor display can be underscanned then this mode of operation may be used when the height of the active picture display is measured. No allowance for overscan by the monitors has been made on the boxes shown in figure 4 but any error will be small for a 10% high target. Care should be taken when making the transparencies to ensure that the reproduction is actually 1:1 as photocopiers may distort the images. As a quick guide, a piece of paper can be cut or folded to represent 10% picture height.

Monitor screen height	5%R image height x width	10%R image height x width	20%R image height x width	50%R image height x width
200mm (12")	10x2.5mm	20x5mm	40x10mm	100x25mm

The overall height to width ratio of the Rotakin is 4:1. The monitor screen height is measured from top to bottom of the area of the displayed picture.

If a non-standard image display is used, eg, split screen or portrait, then the impact on observer viewing conditions should be determined and a method of image size measurement established.

FIGURE 4 ***Screen overlay for checking Rotakin image size on a 200mm high monitor screen.***



6.3 Recording camera set-up positions

Weaknesses in the system can occur if cameras are not repositioned and adjusted accurately after maintenance. This can lead to cameras not covering the expected area, and images being out of focus. Using a view foil overlay for the screen, key points in each camera view can be marked and the overlay for the appropriate camera used as reference to check alignment.

6.4 Recording response times and related data

As well as recording the time taken to find the target, other information might be useful when assessing the results and deciding on a course of action, eg, target too small, poor lighting, search too complicated, scene too busy to find targets, unreasonably short time allowed for search. In the latter case, testers might recommend a longer search time. If different observers take different times to detect the target, the average time or the spread or the worst case or all should be noted as agreed. A clear note must be made of what the recorded values represent. Any known, or suspected reason, for a large spread of response times should be noted; this could be due to different observation conditions: lighting, weather, observer fatigue, distractions, different start point for test, different observer

position. There may also be different operator skill or training levels or operators may simply have learned from seeing earlier tests. (See also Analysis of results and action.)

A note should be made of whether the target was actually displayed on the monitor, describing it as very clear, clear, indistinct or as not discernible.

6.5 Video tape record of tests

A video tape recorder (VTR) should be used to record the results, if they are required for later analysis or comparison with other test results. For a commissioning test, the recordings will serve as a direct record of what took place. These will allow the essential parameters of the Rotakin test: the percentage of picture height of the target, the area covered and the time taken, to be measured or checked after the event if that is necessary. The pictures will show where the targets were deployed and how well their images were presented to the video tape recorder. It will say nothing about how the images were presented to the observer or his reaction to them. This could prove helpful if there was some question as to whether it would have been reasonable for the observer to have seen the target if the information had been presented to him properly. The monitor may be poorly adjusted, awkwardly placed or there may be reflected light making viewing difficult. A camcorder might be used to produce a view of the monitor screen itself, particularly where the directly recorded video picture is felt not to be representative of what the observer sees. Care must be taken in making and interpreting this type of record. For instance, a black horizontal bar will move over the image if the camcorder is not synchronised with the image display.

An audio track added to the recording could carry the operator's comments, or perhaps a commentary from the observer, to show when the tests commenced, when the operator responded and when the operator decided on what he had seen. The recording can then be used to assess system response time.

If the system requirement is for the observer to make immediate decisions, based on live picture details presented to him, assessment of performance from a video recording of the results might not be appropriate. The recording would have to be of sufficient quality not to compromise the overall system performance, assuming the recording was able to show adequately what the operator saw.

If the test is part of a series aimed at establishing criteria for future designs, other relevant details should also be recorded. These could include details on the camera and lens, type of lighting and levels, monitor size and viewing distance, date of installation, etc. Care must be taken when comparing recordings taken under different conditions: like should be compared with like. A video tape recording will not be an exact reproduction of the input camera signals. In particular, resolution and signal to noise ratio may well be limited by recorder performance. This may make the comparison a test of video recorder performance rather than that of the cameras.

6.6 Video tapes as system outputs

If the video taped record is an essential part of the security system, it must be assessed accordingly. Questions should be asked of those who will be using the pictures from the recordings (OR box 14). These questions might include can you recognise people; can you read number plates? These requirements would be specified in OR checklist, box 4. The final assessment of the recorded results should be made under as near operational conditions as possible. If the output to the recorder is multiplexed or the recorder operates other than in real time, it is vital to ensure that the tape has been made using those facilities. It is also important to ensure that facilities are available to allow the tape to be replayed for assessment!

6.7 Video tape recorder

A VTR and reference monitor used to record the tests should be properly linked into the system (their position in a chain of video switchers, site monitors and site VTRs, may effect the quality of picture they produce).

If a video recorder is not a specific element of the system under test, arrangements should be made to provide one. Ideally, the recorder and tapes should be of high quality (eg, SVHS) and the recorder should be fully serviced (eg, with clean recording heads). It is suggested that more than one tape should be available so that, daytime tests and night-time tests are separated. The model and serial number of the recorder should be noted in case its performance is later questioned.

6.8 CCTV monitors

CCTV monitors vary in quality and in facilities available on them. Monitors may have been continuously switched on for many months so that the quality of displayed images, whilst adequate at the time of installation, may have degraded. Monitors require servicing and periodic replacement. The test team should be equipped with a good quality monitor of their own with underscan/overscan facilities. This may be used as the reference monitor for the tests. It can be wired into the system instead of, or in addition to, one of the site monitors to distinguish between faults due to poor camera images and poor image presentation on the monitors.

It should be noted that the picture obtained from a reference monitor on underscan will not be the same as that from a site monitor which does not offer underscan. Whilst the fields of view obtained by the site monitors should be used when marking the site map and describing the camera pictures, the difference between these and those produced by an underscanning reference monitor could be noted and used to show what would be achieved if monitors with underscan were employed.

7 ANALYSIS OF RESULTS AND ACTION

The performance test results should be compared with the specification and the OR checklists. If this is a commissioning test, special care is called for as acceptance will pass responsibility for correcting shortfalls from the supplier to the customer. Any weaknesses in the OR, test specification, test procedure or contract with the supplier potentially leave the customer exposed to having to take delivery of a flawed system.

When analysing the results, it should be remembered that the performance may not need to be perfect under all conditions and this will be reflected in box 19 of the checklists. It may not have been possible to carry out all of the tests, for instance, those requiring special conditions not present at the time of test may have been deferred. The length of time before deferred tests are carried out should be agreed.

There may be other matters in the contract with the supplier which need to be cleared before the system can be accepted and paid for. It may be necessary to demonstrate compliance with other technical requirements, relevant standards, health and safety requirements or ability to be operated in accordance with codes of practice, before the system can be put into, or continue in service.

If there are no discrepancies then the performance test is passed.

Issues identified as requiring further action or analysis should be noted. If there are discrepancies, the cause should be determined as failures to achieve the necessary performance can be due to factors not to do with the CCTV equipment itself. The list of possible faults at the end of this section is by no means exhaustive. It is vital to ensure that responsibility for issues such as lighting and site management are clear and that potential failures in testing are resolved before the test programme commences. Poor project and site management are common causes of test failures. For example, obstructions to camera views can result from new construction, vehicle storage or poor maintenance of grass and hedges. On green field sites it is not uncommon to find that after the security contract has been let substantial changes to occur to boundaries, lighting and buildings without the security arrangements being reviewed. Unless effective project management and timely communication is in place then security arrangements can be doomed before they are even put in place. Amendments to the contract can take costs well over budget.

If responsibility for failure lies with the contractors then they should be invited to comment on the failure and propose a solution. It may be possible to review the OR to confirm that the performance level called for is essential. If not, it may be possible to negotiate a local easement of the OR without compromising security. If this is not possible and the contractor is unable to rectify the situation then the system should be rejected.

Exceptionally, with an existing system, problems may be so serious that it is necessary to take the system out of service rather than waste further resources on attempting to rectify it.

The stakeholders shown in box 16 should be made aware of the outcome of the testing. It may be advantageous to keep them informed at all stages and to witness the testing.

7.2 Performance test failures

Reasons for performance test failures should where possible be noted during the test. The following are examples:

System design

- target too small
- target concealed from view
- area not covered by cameras
- equipment too slow
- equipment difficult to operate
- equipment malfunction
- excessive alarm rate
- search task too complex
- inadequate viewing conditions
- light glaring on the monitor screen
- images not focused
- focus error due to lack of depth of field
- movement blur

Lighting

- blinding the camera
- shadows concealing the target
- insufficient contrast between the target and background

Test management

- incorrect instruction to observer
- misunderstanding by observer
- operator prompt incorrect
- operator prompt failed
- inadequate search strategy
- observer distracted
- observer otherwise occupied.

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