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|  | Performance Specification for Display Cases |

* **All cases must conform to the following specifications except where indicated on the Display Case Schedule supplied by designers.**
* **This document to be read in conjunction with Display Case Schedule, design drawings and all other tender documentation.**

**1. General**

1.1 Minimum working life expectancy of 10 years.

1.2 Guarantee of 3 years (minimum) required for all working parts and warranty of 5 years (minimum) for lighting.

1.3 All design and construction details to be agreed by NML prior to manufacture. Detailed workshop drawings will be signed off prior to production.

1.4 All materials to be selected from NML’s approved list where possible. For any other materials **not** on the list, product data, samples (if required) and documented proof of being passed ‘Permanent’ by Oddy Test to be supplied to NML Conservation for evaluation (See 6).

**2. Construction:**

2.1 Framed or unframed cases are acceptable, although may be dependent on security requirements (see Section 7 & Display Case Schedule)

2.2 Construction to be robust and durable and appropriate to allow for all display, loadbearing and access requirements.

2.3 All external surface finishes to be of the highest standard, with no visible flaws.

2.4 The case must not endanger staff, visitors or objects in its exhibition location, or during opening, closing or moving.

2.5 All electrical and mechanical components to conform to appropriate British Standard.

2.6 Power sources should not affect environmental monitors. Electromagnetic compatibility (EMC) should be in accordance with the appropriate EEC Directive.

2.7 All case voids containing power sources and cables to be appropriately ventilated to prevent heat gain within the case structure.

2.8 All power carrying cables to be insulated to prevent heat gain within the case in accordance with current Institute of Electrical Engineers (IEE) Regulations.

2.9 All internal case constructions to be resistant to water ingress from above.

2.10 All exterior and base construction materials to be fire retardant or fire proofed as finished coat.

2.11 Gross weight and internal load bearing limits of baseboards of case to be provided by manufacturer and to be included in Operation & Maintenance (O&M) Manuals

2.12 Where possible (dependant on size) cases should be removable in one piece by pallet truck, specialist lifting equipment or forklift, as applicable, without the need for dismantling. Bases must be sturdy enough to allow lifting by such equipment. Bases must indicate lifting positions.

2.13 Vertical partitions should be removable, rigid and secure once positioned.

2.14 All screws and fixings to be corrosion inhibited.

2.15 Display cases should be manufactured from standard, replaceable components, where possible.

**2. Size:**  see designer’s drawings and Display Case Schedule.

**3. Glass:**

3.1 Thickness 11.5mm minimum or unless otherwise agreed, to requirements.

3.2 Where the objects/items to be displayed within a case are of a very high individual value or of a very sensitive nature or high security risk a glass thickness of at least 14.5mm may be required by the National Security Advisor for NML to meet the requirements for the Government Indemnity Scheme. Additional security methods may also be required as outlined in section 7.   
*Security issues of this nature should be raised early on in any project development to allow for the confirmation of security requirements, display case specification and costings.*

3.3 Glass must be laminated (2 ply minimum – e.g. glass-core-glass).

3.4 Glass to comply with BS 5544 specification for security glass.

3.5 Glass to be bonded with clear solvent and acid free sealants (see 5 below), unless otherwise agreed. Acetoxysilicones should **not** be used.

3.6 Colour: all quotes to be based on standard glass used (unless designers specify otherwise e.g. “water white” low-iron, low-reflective glass – see Display Case Schedule for detail).

**4. Locks:**

4.1 Abloy Sentry Master Key System – SY364-SN6.

4.2 Keys must conform to Security Code White.

4.3 Locks must be flush fixed, with bezel not protruding from case structure.

4.4 Locks required for case volumes, facilities trays and light boxes where these are fitted (see Display Case Schedule).

4.5 Display Case Contractor to ensure that lock fitting must be in accordance with manufacturers’ instructions.

4.6 It should not be possible to remove the key from lock until the case is shut and secured.

4.7 Suiting of locks to be agreed with NML. Keys to be provided in accordance with NML’s requirements, with keys clearly labelled and supplied with information on suiting layout.

**5. Interior:**

**5.1 *Materials – General Considerations***

5.1.1 All materials to be durable and maintainable.

5.1.2 All materials to be inert and stable, proven for safe contact with objects without releasing corrosive or tarnishing vapour. All materials for case interiors to be selected from NML’s approved list where possible. For any other materials not on the list, product data, samples (if required) and documented proof of material being passed ‘Permanent’ by Oddy Testing to be supplied to NML for evaluation.   
Oddy Tests take a minimum of 4 weeks for a result. As some materials can fail material testing, alternatives require selecting and further testing may be required, the programme must take this time requirement into account.

5.1.3 Safety data sheets for all materials used should be approved by NML prior to manufacture.

5.1.4 Minimum periods required for curing/off-gassing before installation of any materials into case:

* adhesives 4 weeks
* glazing, water based paints + varnishes 2 weeks
* sealants 1 week

**5.2 *Facilities trays***

5.2.1 See Display Case Schedule for cases requiring a facilities tray.

5.2.2 Facilities trays to be accessible from the case exterior, without having to go through the display volume, and lockable.

5.2.3 Facilities trays must hold sufficient conditioning material for case contents and volume (see Display Case Schedule for conditioning material specification).

5.2.4 Facilities tray to be air tight to the case exterior.

5.2.5 Location and size of facilities trays to be agreed with NML prior to manufacture (indication on workshop drawings).

**5.3 *Shelves***

5.3.1 Structure of all cases should allow for installation of shelves at a later date.

5.3.2 Shelves to be removable, height adjustable, secure and provide protection from vibration.

5.3.3 Safe loading limits for shelves and shelf supports to be supplied by the case manufacturer and agreed with NML prior to production. Loading limits to be noted in O&M Manual.

**5.4 *Dress panels***

5.4.1 NML approves of three primary methods of interior construction:

* Forrex™ or Foamalux™ PVC rigid board is preferred for use for dress panel construction, minimum thickness of 19mm for load bearing and structural requirements and in agreement with NML. Dress fabric should be fixed using approved tapes and/or staples may be used. Only tapes and adhesive film currently approved may be used (see Approved Tapes below). Where paints are used, as agreed with NML (see Display Case Schedule) these should be approved water based emulsion paints applied to a pre-“keyed” surface. Only primers approved by NML be used, where these are appropriate, for use on Forrex™ or Foamalux™ PVC rigid board and approved ‘Permanent’ by Oddy Testing and in agreement with NML
* Metal panels with powder-coated finish. Powder-coating system and process to achieve fully inert, fully cured finish.
* Where internal structures require greater load bearing strength, and in agreement with NML, Formaldehyde free MDF (e.g. ZF MDF) may be approved if covered with a heat-sealed barrier film such as Moistop, wrapped with NML approved fabric or coated with four coats of Dacrylate™ (or agreed alternative) water based (non-V.O.C. emitting) acrylic lacquer. Fabric should be fixed using approved tapes, and the barrier film over ZF MDF should **not** be punctured i.e. fabric should ***not*** be stapled. Tapes and adhesive film currently approved include:

**Approved Tapes:**

* Gudy 870 transfer adhesive
* Lomacoll double-sided mounting adhesive
* 3M 415 double-sided tape
* 3M 425 Scotch aluminium adhesive tape

5.4.2 Dibond, Lucabond or Hexlite may be used in certain circumstances, after prior approval from NML.

5.4.3 To ensure a good air movement between facilities tray and case interior, the base of cases with facilities trays should have 10 mm holes over 25% of the surface area (see 5.2 above). Note to Designers – the interiors of such cases must be planned not to inhibit the air exchange between the facilities tray and case interior.

5.4.4 Bases must be removable, rigid and adequately support display requirements. Case structure to have sufficient load-bearing capacity for display and installation. Manufacturer to specify maximum load bearing limits. Loading limits to be noted in O&M Manual.

5.4.5 A sample of the dress panel should be provided to NML at the outset of contract for approval.

**6. Case external material:**

6.1 Plinth – fire retardant, formaldehyde free MDF, blockboard faced with laminate; or steel or aluminium laminate or alternative with prior agreement by NML.

6.2 Bases to have the facility of accepting appropriately rated levelling feet.

6.3 All metal parts to be powder coated, to achieve inert, fully cured finish as above.

**7. Case structure/security:**

7.1 Framed case: steel, flanged corners (e.g. 1.6-3mm thick mild steel, depending on case size) covering glass edges by min 13mm, preferably 25-30mm.

7.2 Suitable fittings for attachment to wall and/or floor to be used where appropriate, depending on size, stability and weight.

7.3 Display Case Contractor to supply and fit contact and vibration sensors by NML approved security system contractor, where specified (see Display Case Schedule). Contractor to liaise with NML approved security system contractor, regarding type of alarm and method of installation and to coordinate activities on-site to ensure smooth progression of the works. Case design to provide adequate space to accommodate door contacts and vibration sensors for wired/telemetric alarm systems (see Display Case Schedule)

7.4 The fitting of any alarms or wiring should not compromise air tightness. Any sealant applied during any alarm or wiring installation should be cured/off-gassed for the specified time before object installation. All alarm wiring should be discrete and not hinder any subsequent access to case interior.

7.5 The Display Case Contractor is to be in attendance when NML approved security system contractor connect and test alarm system.

7.6 Maximum load limits to be provided by the case manufacturer for all load-bearing surfaces (shelves, dress panels, case tops etc).

7.7 Additional security provision may be required in some instances, for example for displays of firearms, very high historic or monetary value items or other security requirements. (See Display Case Schedule for details).

7.8 Where display cases are demountable, electrical wiring should be able to be easily, safely and securely connected or disconnected and robust enough for use (see Display Case Schedule).

**8. Access:**

8.1 Safe access mechanisms are required for all parts of the case structure.

8.2 For hinged doors, method of supporting doors when opened must be clearly explained, , where such support is required. Stability of case must not be compromised by access methods.

8.3 All services to be fully accessible from outside the case volume where possible (in particular light fittings, fibre optic projector, facilities tray, miniClima air conditioning units etc.) – i.e. without access needed through the display volume.

8.4 All case enclosures to be fully accessible for loading/unloading, cleaning and maintenance.

**9. Air tightness:**

9.1 Maximum air exchange rate of 0.1 air changes per day. Any other air exchange rates greater than this to be agreed with NML and documented prior to contractual agreement (See Display Case Schedule)

9.2 Prior to acceptance and handover of display cases the display case manufacturer should be able to show, by employment of an independent air-tightness test contractor (selected in agreement with NML), that the air-tightness of a display case meets or surpasses the maximum air exchange rate. Dependent on the number of display cases procured NML shall select a proportion or all of the display cases for testing, in agreement with the display case manufacturer, taking into account display case types, sizes or the nature of objects to be displayed within. Copies of air-tightness certificates to be provided to NML when tests have been completed.   
NML reserves the right for their staff to test display cases to ensure that they meet the air tightness specification prior to acceptance and object installation.

9.3 The case installation programme must allow time for air-tightness testing and any remedial works required prior to object installation, as agreed with NML. Display case manufacturer to coordinate over times and provide adequate access for testing to be carried out during the fit out period, where required.

9.4 Where access is required to the case interior for fitting of alarm contacts or LED or fibre optic lighting, this should not compromise air tightness.

**10. Environmental Control (electro-mechanical):**

10.1 Selection of electro-mechanical air treatment equipment for environmental control, such as miniClima™ units, their location and that of service pipework in relation to the display case should be in agreement with NML.

10.2 Access to maintain air-treatment units should not put staff at risk of injury and where possible should be accessible without the use of ladders, in agreement with NML.

10.3 Where air treatment units and their water reservoirs are required to operate on top of display cases, they should located within drip trays to prevent water being spilt onto the top of the display case, other equipment or services. They should be easily accessible on one side of the display case and without having to lean over any additional structure that could pose a heath & safety risk.

10.4 In general, treated air outward from such air treatment units should enter the display case display volume through a discreet grill or hole at the top of the display case. Exhaust air returning to the air treatment units should be taken from a discreet hole or grill diagonally opposite the treated air input at the bottom of the display case display volume, in prior agreement with NML.

**11. Lighting:**

11.1 A warranty of 5 years (minimum) is required for all lighting. See Display Case Schedule for specific lighting requirements.

11.2 Adequate lighting to be provided to enable lighting to any part of the case at brightness levels between 0 – 300 lux. Display Case Manufacturer to ensure LED lighting is fully dimmable down to at least 50 lux or below with no significant colour temperature change.

11.3 Light source must be independent of case volume except where these are cool-running LED lights mounted within internal case structures, as agreed with NML. Dimmable down to 50lux or below with no significant colour temperature change.

11.4 The lighting must not generate temperatures within the case in excess of 2ºC above the ambient room temperature, and light boxes should have adequate ventilation.

11.5 Fibre optic projectors, and power supply units, must not be located underneath the display space and ideally should be located remote from the case. Projectors should use LED projector bulbs with a colour temperature between 3000-4000°K, as agreed with NML (see Display Case Schedule.)

11.6 The barrier between the lightbox and the case interior must incorporate filters for UV and IR radiation.

11.7 UV filters should meet the accepted conservation specification, which takes the transmittance of the filter at 550nm as a reference. The filter should have a transmittance of less than 1% of the reference at 320nm and 380nm, and a transmittance of less than 50% of the reference at 400nm.

11.8 Light boxes to be secure and lockable (see section 4 above).

11.9 Wiring to lights to be able to be safely and independently isolated within the light attic (See Display Case Schedule)

11.10 No significant upward light spillage from the lightbox.

**12. Numbering:**

12.1 Unique display case numbers, for the purpose of identification, will be provided by NML to the display case manufacturer prior to display case production.

12.2 The five digit display case number to be etched on to the front face all cases, as follows

a) Desktop cases: 18 pt Helvetica Medium

b) Standard cases (all other): 24 pt Helvetica Medium

c) Positioning:

* In general, to bottom right corner of front glass pane.
* Desktop type display cases – bottom right corner of front glass pane (vertical), or bottom right hand corner of main top pane where no front pane is present.

**13. Maintenance and Hand-over**

13.1 Full Operations and Maintenance (O&M) Manual to be prepared prior to the end of the contract period. To include: as-built drawings, schedule giving full specification and supplier details for all replaceable parts, detailed instructions for all necessary operations and access. NML to review draft manual before practical completion.

13.2 Training session to be provided for relevant NML staff in full case operations, including use of hinged doors, facilities trays, access to lighting, access to and use of air treatment equipment (e.g. MiniClima units) where applicable etc.

13.3 In particular, safe method of opening, closing and securing of doors to be demonstrated.

13.4 **Key & display case hand-over:** After all snagging has been completed and to the satisfaction of NML.

13.5 **Defects Period and Warranty Period:** Agreed between the Display Case Manufacturer and NML, as per contract.