

Appendix I - Mobile Operation Procedures

1. Mobile Operation

1.1 Mobile operations are those activities or operations taking place on roads (but not contained within a fixed site) where operation vehicles are progressing with the flow of traffic at a speed not exceeding 25km/h or the speed specified by the manufacturer of the Truck Mounted Attenuator (TMA), whichever is the less. In these operations, works vehicle(s) may move along the road intermittently or continuously, but planned stops shall not be more than 15 minutes each. Mobile operations mainly include the following activities: -

- (i) setting up lane closure,
- (ii) removing lane closure,
- (iii) road lighting maintenance,
- (iv) picking up litter,
- (v) landscaping work,
- (vi) road sweeping and cleansing, and
- (vii) patching pot-holes.

1.2 Mobile operation procedures shall be adopted on expressways. However, mobile operation procedures may also be adopted in other types of roads if deemed necessary by the person responsible. The general requirements for carrying out mobile operations are set out in para. 2. The working procedures for setting up lane closure, removing lane closure and other types of mobile operations (road lighting maintenance, picking up litter, landscaping work, road sweeping and cleansing, and patching pot-holes) are set out in para. 3, 4 and 5 respectively. Para. 6 sets out the safety precautions in carrying out mobile operations. Procedures for lane changing during mobile operations are set out in para. 7.

2. General Requirements

2.1 Depending on the traffic conditions, call the Police for assistance when necessary especially during the hours of darkness before the mobile operation.

2.2 Under the following circumstances, mobile operation procedures shall not be carried out, except in emergencies: -

- (i) Work requiring WV(s) to stop for more than 15 minutes.
- (ii) Inclement weather.
- (iii) Traffic flow is significantly affected.

2.3 During the mobile operation,

- (i) the works vehicle(s) (WV(s)) must be escorted by a shadow vehicle (SV) equipped with a Level 3 TMA. All SVs mentioned in this Appendix refer to SVs equipped with a Level 3 TMA. The TMA should be unfolded during mobile operations. The Level 3 TMA shall comply with the test requirements for speed of 100km/h as set out in United States National Cooperative Highway Research Programme (NCHRP) Report 350. All the WV(s) and the SV shall be equipped with a Multiple Sequence Warning Sign (MSWS). A typical arrangement is shown in Fig. A1 in Annex A - "Mobile Lane Closure";
- (ii) the Level 3 TMA shall be folded up or unfolded at a suitable place. A suitable place refers to an area where the folding or unfolding of TMA shall not cause any disturbance to any oncoming

or nearby vehicles. Hard shoulders of widths not less than 3m and with sufficient visibility distances to oncoming vehicles are considered as a suitable place where the TMAs can be folded up or unfolded. Carriageways just in front of the give way and stop lines at slip roads are also considered as suitable places for folding up the TMAs;

- (iii) the distance between the WV(s) and the SV shall follow the buffer distances shown in Table B1 in Annex B - "Table for Buffer Distance". For moving works at a bend or location with inadequate sightline distance, the SV shall stay before the start of the bend or before the crest of a slope. The SV shall also keep a distance of at most 100m from the WV(s);
- (iv) all the WV(s) and the SV shall be equipped with communication facilities in order to maintain effective communication. All communication shall be conducted in a manner in full compliance of the Road Traffic (Traffic Control) regulation 42(1)(g); and
- (v) all the WV(s) and the SV must switch on the vehicle's hazard warning lights, and the strobe lights and the MSWS at the auto mode, to alert the oncoming vehicles to use other traffic lanes. In addition, drivers of the WV(s) and the SV shall pay attention to the road traffic at the back.

2.4 The use of SV equipped with a Level 3 TMA may be exempted on slip roads where

- (i) speed limit of the section of the road is below 70km/h, or
- (ii) topographic conditions of the road rendered the use of a Level 3 TMA not possible.

3. Working Procedures for Setting up Lane Closure

3.1 The following working procedures shall be observed in setting up of lane closure: -

- (i) Erecting advance warning signs,
- (ii) Setting up the approach taper, and
- (iii) Completing the lane closure set-up.

3.1.1 Erecting Advance Warning Signs

- i) For closure on a fast lane (or, on fast lane plus second fast lane), advance warning signs and the high intensity flashing beacons shall be erected alongside the slow lane first and then along the fast lane. For closure on a slow lane (or, on slow lane plus second slow lane), advance warning signs and the high intensity flashing beacons should be erected alongside the fast lane first and then along the slow lane. High intensity flashing beacons are required during the hours of darkness. Advance warning signs shall be displayed at 600m, 400m and 200m in advance of the closure area.
- ii) When erecting warning signs, the WV(s) and the SV must move slowly and the WV(s) shall stop at 600m from the closure area to erect the first warning sign.

iii) Afterwards, the WV(s) shall move slowly to 400m and 200m from the closure area to erect other warning signs respectively. After all advance warning signs are erected, the WV(s) and the SV shall leave the road under one of the following two modes:

(a) The SV shall have the Level 3 TMA folded up at a suitable place (refer to para. 2.3 (ii) for the definition of suitable place). If so, the strobe lights, the MSWS and the vehicle's hazard warning lights of the WV(s) and the SV shall be switched off when the traffic conditions allow. Then the WV(s) and the SV shall leave the road at a normal speed and the speed of the SV shall not exceed the speed specified by the manufacturer of the TMA, or

(b) if there is no suitable place for the Level 3 TMA of the SV to be folded up, then only the WV(s) shall leave the road in the way as specified in para. (a) above. For the SV, its strobe lights, the MSWS and the vehicle's hazard warning lights shall remain switched on, and shall leave the road at a speed not exceeding the speed specified by the manufacturer of the TMA.

iv) The WV(s) and the SV shall then go to the other side of the carriageway for displaying the other set of advance warning signs as required in para. i) above by repeating the procedures in para. ii) to iii) above.

3.1.2 Setting up the approach taper

- i) After erecting advance warning signs, the WV(s) and the SV shall go to the approach taper location to prepare for setting up on the same lane. Before letting workers get off for setting up of approach taper, the SV shall stop at a suitable location away from the approach taper so as to give a sightline distance of 200m to the approaching vehicles. The relevant standards on setting up the approach taper are given in the following tables or sections of the current CoP: -

* Signs:	Tables B and C
* Length of approach taper:	Table D
* Traffic cones:	Para. 3.8
* Lantern spacing:	Para. 3.12

A copy of these tables and sections were extracted and attached as Annex F for easy reference.

(refer to Annex C - "Lane Closure Arrangement" for the general arrangement).

- ii) A MSWS and a barricade sign board must be placed at the end of the approach taper. This is to alert the oncoming vehicles to use other traffic lanes.

3.1.3 Completing the lane closure set-up

- i) After setting up the approach taper, the WV(s) shall move forward slowly for placing traffic cones, arrow signs, and low intensity warning lanterns until the end of road closure in

accordance with para. 3.8, 3.12 and Table C of the current CoP (See Annex F). When the WV(s) is moving forward to set up the lane closure, the SV shall still stay outside the approach taper of the lane closure. After setting up the whole lane closure, the WV(s) and the SV shall then leave the road under one of the modes as detailed in para. 3.1.1 iii).

4. Working Procedures for Removing Lane Closure Set-Up

4.1 In removing the lane closure set-up, the lane closure procedures shall be carried out in the reverse order to those of setting up lane closure: -

- (i) Removing the lane closure set-up
- (ii) Collecting all advance warning signs

4.1.1 Removing the lane closure set-up

- i) The WV(s) shall move slowly to and stay at the end of the end taper of the lane closure. If the lane changing movements involved in these actions are likely to cause disturbance to the traffic flow, the entry arrangements and procedures as specified in Appendix III shall be followed.
- ii) The SV, with its TMA unfolded and with the strobe lights, MSWS and vehicle's hazard warning lights switched on, shall move to the front of the approach taper and stay there.
- iii) Right after the SV has come to the approach taper, the WV(s) shall move backward very slowly for collecting the signs, cones and lanterns

from the end taper.

4.1.2 Collecting all advance warning signs

- i) After removing the approach taper, the WV(s) shall have the strobe lights, the MSWS and the vehicle's hazard warning lights switched off when the traffic conditions allow, and then leave the road at a normal speed and prepare for going back to the first advance warning sign with the escort of the SV.
- ii) At the same time, either:
 - (a) the SV shall have the Level 3 TMA folded up at a suitable place (refer to para. 2.3 (ii) for the definition of suitable place). If so, the strobe lights, the MSWS and the vehicle's hazard warning lights of the SV shall be switched off when the traffic conditions allow. Then the SV shall leave the road at a normal speed not exceeding the speed specified by the manufacturer of the TMA and prepare to escort the WV(s) to go back to the first advance warning sign, or
 - (b) if there is no suitable place for the Level 3 TMA of the SV to be folded up, the strobe lights, the MSWS and the vehicle's hazard warning lights of the SV shall remain switched on. Then the SV shall leave the road at a speed not exceeding the speed specified by the manufacturer of the TMA, and prepare to escort the WV(s) to go back to the first advance warning sign.

- iii) Before the WV(s) and the SV come to the first warning sign, the strobe lights, the MSWS and the vehicle's hazard warning lights of the WV(s) and the SV shall be switched on and the TMA unfolded at a suitable place beforehand.
- iv) After arriving at the first advance warning sign, workers from the WV(s) shall start collecting the advance warning signs and high intensity flashing beacons.
- v) After collecting all the signs and beacons on one side of the road, the WV(s) and the SV shall leave the road under one of the two modes as detailed in para. 3.1.1 (iii) and go back to the first advance warning sign on the other side of the carriageway for collecting the remaining set of advance warning signs and high intensity flashing beacons.

5. Working Procedures for Other Types of Mobile Operations
(Para. 1.1 (iii) to (vii))

5.1 The following working procedures shall be followed when carrying out mobile operations including road lighting maintenance, picking up litter, landscaping work, road sweeping and cleansing, and patching pot-holes on an expressway (except for road bends and special road sections with inadequate sightline): -

- (i) The WV(s) and the SV shall move slowly along the slow lane or fast lane with their strobe lights, MSWS and vehicle's hazard warning lights switched on and the TMA unfolded at a suitable place beforehand, and with a speed not more than 25km/h or the speed specified by the

manufacturer of the TMA, whichever is the less.

- (ii) The buffer distances between the WV(s) and the SV shall be maintained in accordance with Table B1 in Annex B.
- (iii) When the work location is identified, the WV(s) and the SV shall communicate well with each other by telecommunication so as to ensure they stop on a safe spot before letting workers come down to the road or commence work on the WV(s).
- (iv) Workers shall work within 3m on the side or in front of or on the WV(s), and shall stay within the traffic lane on which the WV(s) and the SV stopped.

5.2 The following procedures shall be followed when carrying out mobile operations including road lighting maintenance, picking up litter, landscaping works, road sweeping and cleansing, and patching pot-holes on a road bend or special road section with inadequate sightline (e.g. a crest): -

- (i) Same as para. 5.1(i)
- (ii) Same as para. 5.1(ii)
- (iii) When the work location is on a road bend or on a road section with inadequate sightline (e.g. after a crest), the SV shall stop at the road section before the road bend or before the location with inadequate sightline such that there is adequate sightline between the SV and the oncoming vehicles. The SV shall also keep a distance of at most 100m from the WV(s).

- (iv) Same as para. 5.1 (iv)

- (v) After the work is completed, the SV shall move forward once the WV(s) has left the road bend or the road section with inadequate sightline. However, to avoid excessive gaps occurring in between the WV(s) and the SV, the SV may need to start moving forward even if the WV(s) has not completely left the road bend or the road section with inadequate sightline. After the SV catches up the WV(s), it shall then maintain proper buffer distances according to Table B1 in Annex B and proceed to the next work location.

5.3 The following procedures shall be followed when carrying out mobile operations including road lighting maintenance, picking up litter, landscaping works, road sweeping and cleansing, and patching pot-holes on an expressway, the work locations of which are on the hard shoulder (except for road bends and special road sections with inadequate sightline).

5.3.1 Hard Shoulder Width not less than 3.3m

- (i) The procedures as described in para. 5.1(i) to (iv) above shall be followed, except that the WV(s) and the SV shall move slowly along the hard shoulder, the MSWS shall be switched off and workers shall stay within the hard shoulder on which the WV(s) and the SV stopped.

5.3.2 Hard Shoulder Width less than 3.3m

- (i) The WV(s) shall move slowly along the hard shoulder occupying part of the slow lane if necessary and

the SV shall move slowly along the slow lane, with their strobe lights, MSWS and vehicle's hazard warning lights switched on and the TMA unfolded at a suitable place beforehand, and with a speed not more than 25km/h or the speed specified by the manufacturer of the TMA, whichever is the less.

(ii) Same as para. 5.1(ii).

(iii) Same as para. 5.1(iii).

(iv) Workers shall work within 3m on the side or in front of or on the WV(s), and shall stay within the hard shoulder on which the WV(s) stopped.

5.4 The following procedures shall be followed when carrying out mobile operations including road lighting maintenance, picking up litter, landscaping works, road sweeping and cleansing, and patching pot-holes, the work locations of which are on the hard shoulder and on a road bend or special road section with inadequate sightline.

5.4.1 Hard Shoulder Width not less than 3.3m

(i) The procedures as described in para. 5.2 above shall be followed, except that the WV(s) and the SV shall move slowly along the hard shoulder, the MSWS shall be switched off and workers shall stay within the hard shoulder on which the WV(s) and the SV stopped.

5.4.2 Hard Shoulder Width less than 3.3m

(i) Same as para. 5.3.2(i).

(ii) Same as para. 5.1(ii).

(iii) Same as para. 5.2(iii).

(iv) Same as para. 5.3.2(iv).

(v) Same as para. 5.2(v).

6. Safety Precautions in Carrying out Mobile Operations

6.1 The following safety precautions shall be observed in carrying out mobile operations: -

(i) The driver of the SV with TMA must have received proper training on driving the vehicle provided by recognized institutions of motoring. Upon satisfactory completion of the training, a completion certificate valid for not more than 3 years will be issued to the driver. Only drivers with valid certificates are allowed to operate vehicles mounted with TMAs.

(ii) Check the WV(s), the SV, the strobe lights, the TMA, the MSWS, the high intensity flashing beacons, the low intensity warning lanterns and the telecommunication equipment to ensure that they can function properly.

(iii) Maintain the buffer distances according to Table B1 in Annex B for the SV and stop at pre-determined locations.

(iv) Workers in the WV(s) must pay attention to the traffic conditions and ensure that it is safe before they get off the WV(s).

(v) Workers should always face the direction of the

oncoming traffic and pay attention to the traffic conditions when erecting warning signs, beacons and traffic cones.

- (vi) Workers must wear proper personal protection equipment such as safety helmets and reflective jackets.

7. Lane Changing during Mobile Operation

7.1 The following procedures shall be followed when the WV(s) and the SV change lane during mobile operation: -

- (i) Lane changing shall be initiated by the SV. Before initiating the lane changing action, the driver of the SV should ensure there is sufficient clearance with oncoming vehicles in the lane that he attempts to change into. The lane changing actions of the WV(s) and the SV shall take place simultaneously or as soon as the traffic condition allows.

- (ii) Right before lane changing, the WV(s) and the SV shall flash the appropriate vehicle's signal lights to indicate to the approaching traffic their intention of lane changing and shall show the appropriate signals in the MSWS to alert the oncoming vehicles to use other traffic lanes. The vehicle's signal light and the MSWS signal shall be coordinated in the following manner:

- (a) When the WV(s) and the SV intend to change from a fast lane to the middle lane, or from the middle lane to the slow lane, during each lane changing action, the vehicle's signal light shall indicate a "go left"

signal to alert oncoming vehicles its intention to go leftward, whilst the MSWS shall show a "hazard" signal to alert oncoming vehicles to use other traffic lane(s).

- (b) When the WV(s) and the SV intend to change from the hard shoulder to a slow lane, from a slow lane to the middle lane, or from the middle lane to the fast lane, the coordination shall be in the manner same as para. (a) above, except that the vehicle's signal light shall indicate a "go right" signal.

- (iii) When the traffic conditions allow, the fleet shall drive at the mobile operation speed to complete the lane changing action.

- (iv) The fleet shall not change more than one lane at one time.

- End -

Appendix II - Lane Closure Arrangement

1. The following lane closure arrangements as shown in Annex C - "Lane Closure Arrangement" shall be adopted under the corresponding circumstances: -

- (i) Fig. C1 - Layout of signs for a slow and a middle lane closure for works on a 3-lane expressway
- (ii) Fig. C2 - Layout of signs for a slow lane closure for works on a 4-lane expressway
- (iii) Fig. C3 - layout of signs for a fast lane closure for works on a 4-lane expressway
- (iv) Fig. C4 - Layout of signs for a fast lane and a second fast lane closure for works on a 4-lane expressway
- (v) Fig. C5 - Layout of signs for a second slow lane and a second fast lane closure for works on a 4-lane expressway
- (vi) Fig. C6 - Layout of signs for a second slow lane closure for works on a 4-lane expressway
- (vii) Fig. C7 - Layout of signs for a slow lane and a second slow lane closure for works on a 4-lane expressway

- End -

Appendix III - Entry and Exit Arrangement
for Vehicle(s) in Road Works

1. Entry and Exit Arrangements and Procedures

1.1 All vehicles entering or leaving the lane closure, regardless of their functions and purposes, shall follow the entry and exit arrangements and procedures described below.

1.2 All vehicles shall enter the lane closure only at the designated entry points as specified in para. 1.4 below. However, a vehicle(s) shall not enter a lane closure through the end taper except removing lane closure as described in para. 4 of Appendix I.

1.3 As a first principle, all vehicles shall leave a lane closure through the end taper. Before a vehicle(s) leaves, the traffic cones at the end taper shall be removed temporarily. When the traffic conditions allow, the vehicle(s) shall exit the lane closure area and accelerate in the same lane to the normal speed before any lane changing actions. Upon completion of the exit action, the traffic cones temporarily removed shall be placed back as soon as possible. If the method specified above is impractical, the alternative exit arrangement in para. 1.4 shall be followed.

1.4 The detailed procedures of the entry and alternative exit arrangements are described in the sub-paragraphs below. The alternative exit arrangement is applicable only if the method described in para. 1.3 above is impractical. A graphical illustration is given in Fig. D1 in Annex D.

(i) All vehicles shall enter or leave the lane closure only at the designated entry or exit

points.

- (ii) Entry or exit points shall be located at straight sections of the roads and a sightline distance of at least 200m from the end of the approach taper is provided as shown in Fig. D1 in Annex D.
- (iii) The entry and exit points shall be delineated by a pair of two-metre high revolving amber light posts as shown in Fig. D1 in Annex D.
- (iv) For entering the lane closure, the vehicle(s) shall be escorted by a SV. All escorting SVs mentioned in this Appendix refer to SVs not equipped with TMAs. However, SVs/WVs equipped with MSWS and strobe lights clearly visible to oncoming vehicles may enter the lane closures without further escorts by SVs. The SV shall have its strobe lights, MSWS and vehicle's hazard warning lights switched on. Before the entry action, the traffic cones placed across the entry point shall be removed temporarily. When approaching the entry point, the SV shall gradually slow down and let the vehicle(s) enter the lane closure. Immediately after the vehicle(s) has entered the lane closure, the SV shall accelerate to the normal speed before any further lane changing actions.
- (v) For exiting the lane closure, the vehicle(s) must be escorted by a SV on the traffic lane adjacent to and outside the lane closure. The SV shall have its strobe lights, MSWS and vehicle's hazard warning lights switched on. Before the exit action, the traffic cones placed

across the exit point shall be removed temporarily. When approaching the exit point, the SV shall gradually slow down and let the vehicle(s) exit the lane closure. Immediately after the vehicle(s) has exited the lane closure, the SV shall accelerate to the normal speed where conditions allowed before any lane changing actions.

- (vi) Immediately after the entry/exit actions, the traffic cones temporarily removed from the entry/exit points shall be placed back to their original positions as soon as possible.

- End -

Appendix IV - Specifications for Multiple SequenceWarning Sign (MSWS)

1. The following paragraphs provide supplementary specifications for MSWS in addition to those given in Section 6 of the current CoP: -

(i) The MSWS shall be a board with a rear facing multiple sequence sign incorporating at least 25 sealed and hooded round beams. The beams shall be of 125mm diameter and shall have variable intensity as shown in Table E1 - "Luminous Intensity of MSWS Lights" in Annex E. The beams shall either be amber coloured spot lights, LED or optic fibre lights, and shall be visible at night and in day conditions. The sign shall be of size not less than 1800 mm wide and 900 mm high. The lights on the sign face shall be capable of being controlled electronically, manually or automatically, dimmable for the sequences as described in para. (a) to (f) below. A graphical illustration of MSWS and the sequences is given in drawing No. MSWS-G in Annex E.

(a) Pass to Left - at least three separate arrows lit so that they appear to move from right to left at a frequency of about 40 cycles per minute.

(b) Pass to Right - as para. (a) but moving from left to right.

(c) Pass to Right and Left - the 15 beams forming a double arrow for mobile lane closure of the middle lane shall be flashing

at about 40 cycle per minute.

- (d) Hazard Warning - the 4 beams flashing at a frequency of between 90 and 150 per minute.
 - (e) A test sequence shall be provided to test if all beams are functional.
 - (f) A test sequence shall be provided to energize all beams to the desired power level for steady state testing of the beam's intensity.
- (ii) The luminance performance shall be regularly monitored to ensure the compliance with the requirements and the MSWS shall be calibrated every three years. Certificates and calibration results to demonstrate the compliance with the luminance requirements shall be produced when required.
 - (iii) The sign shall be connected to a suitable low voltage d.c. power supply fixed in the vehicle. The driver of the vehicle must be able to operate and control the MSWS whilst driving.
 - (iv) The rear details of WV installed with MSWS are shown on drawings no. MSWS-WV and MSWS-SIGN in Annex E. The details are summarized as follows:
 - (a) The MSWS shall be mounted with its base not less than 3300 mm above road level on a steel frame.
 - (b) The WV(s) shall also be equipped with a high mount strobe light bar. The light bar shall

be of amber colour with 2 high intensity strobe light bulbs, 2 revolving lanterns, 2 diamond mirrors and 2 V-shaped mirrors. The strobe light bar shall be of minimum 18,000 candela output able to be automatically dimmed to 1,800 candela during the hours of darkness with 60-80 flashes per minute. The revolving lantern shall flash 140-160 times per minute.

- (c) Other than the MSWS and the strobe light bar, the WV(s) shall also be equipped with a barricade sign with a height of 1150mm and with a width being the smaller of 2050mm or the width of the vehicle. The WV(s) shall also have a rear mounted sign frame capable of securely mounting the two signs as shown on drawings no. MSWS-WV and MSWS-SIGN.
- (d) If the MSWS cannot be mounted on the WV (such as a road sweeper), the MSWS may be mounted on a trailer on tow by the WV as an alternative.
- (v) For the SV, a MSWS, a strobe light bar and a barricade sign shall also be installed in accordance with para. (iv)(a), (iv)(b) and (iv)(c) above respectively.
- (vi) All WV(s) and SV shall be conspicuously painted golden yellow to BS 5252F: 1976 (1986) Colour 08E51.

- End -