VOLUME 9 NETWORK - TRAFFIC CONTROL AND COMMUNICATIONS
SECTION 4 SYSTEMS DESIGN

PART 3

TA 74/05

MOTORWAY SIGNALLING

SUMMARY

This issue of TA 74 introduces a revised Annex A that incorporates Interim Advice Note 27/99 (IAN 27/99) that introduced the Motorway Signal Mk 3 (MS3) and Interim Advice Note 43/02 (IAN 43/02) that clarifies but does not increase the standard of provision. Annex A is now England and Northern Ireland only.

INSTRUCTIONS FOR USE

This Advice Note is to be incorporated in the Manual.

1. This document supersedes TA 74/97.
2. Remove Contents pages for Volume 9 dated February 2004.
3. Insert new Contents pages for Volume 9 dated November 2005.
4. Remove TA 74/97 from Volume 9, Section 4, Part 3.
5. Insert TA 74/05 into Volume 9, Section 4, Part 3.
6. Archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from the Stationery Office Ltd.

THE HIGHWAYS AGENCY

SCOTTISH EXECUTIVE

WELSH ASSEMBLY GOVERNMENT
LLYWODRAETH CYNULLIAD CYMRU

THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND

Motorway Signalling

Summary: This issue of TA 74 introduces a revised Annex A that incorporates Interim Advice Note 27/99 (IAN 27/99) that introduced the Motorway Signal Mk 3 (MS3) and Interim Advice Note 43/02 (IAN 43/02) that clarifies but does not increase the standard of provision. Annex A is now England and Northern Ireland only.

REGISTRATION OF AMENDMENTS

Amend No	Page No	Signature & Date of incorporation of amendments	Amend No	Page No	Signature & Date of incorporation of amendments

REGISTRATION OF AMENDMENTS

Amend No	Page No	Signature & Date of incorporation of amendments	Amend No	Page No	Signature & Date of incorporation of amendments

VOLUME 9 NETWORK - TRAFFIC CONTROL AND COMMUNICATIONS
SECTION 4 SYSTEMS DESIGN

PART 3

TA 74/05

MOTORWAY SIGNALLING

Contents

1. INTRODUCTION

1.1 General

1. This Advice Note describes the different types of motorway signals available and provides guidance for preliminary and detailed scheme design.

1.2 Scope

1. This Advice Note is applicable to motorway signalling schemes. It is also for use in the design of signalling within motorway communications, motorway construction and improvement schemes.

2. The specific requirements for each Overseeing Organisation are contained in the relevant Annex to this Advice Note. They are as follows:

Annex A for England and Northern Ireland;
Annex B for Scotland;
Annex C for Wales.

3. This Advice Note is intended to be used by Overseeing Organisation staff, their consultants, Agents and maintenance contractors.

4. Any reference to 'the Regulations' or 'the Directions' is a reference to the Traffic Signs Regulations and General Directions 2002 applicable to England, Scotland and Wales. In Northern Ireland the relevant legislation is the Traffic Signs Regulations (Northern Ireland) 1997.

1.3 Related Standards and Advice Notes

1. The Technical Directive relating to the provision of signalling on motorways is TD 46 : Motorway Signalling.

2. The following Advice Notes are of relevance:

TA 70 : Introduction

TA 71 : Design and Implementation (Overview)

TA 72 : National Motorway Communications Systems (NMCS)

1.4 Implementation

1. The appropriate Annex should be used forthwith on all motorway communications, motorway construction and improvement schemes currently being prepared, provided that, in the opinion of the Overseeing Organisation, this would not result in significant additional expense or delay progress. Design Agents should confirm its application to particular schemes with the Overseeing Organisation.

2. REFERENCES

1. Design Manual for Roads and Bridges (DMRB): Stationery Office Ltd

TD 46 Motorway Signalling (DMRB 9.1.1)

TA 70 Introduction (DMRB 9.2.1)

TA 71 Design and Implementation (Overview) (DMRB 9.3.1)

TA 72 National Motorway Communications Systems (NMCS) (DMRB 9.4.1)

3. ENQUIRIES

All technical enquiries or comments on this Advice Note should be sent in writing as appropriate to:

Divisonal Director
(Safety & Information)
Highways Agency, Room 4B
Federated House
London Road
Dorking
Surrey RH4 1SZ

A J PICKETT
Divisional Director

Chief Road Engineer
Scottish Executive
Victoria Quay
Edinburgh
EH6 6QQ

J HOWISON
Chief Road Engineer

Chief Highway Engineer
Transport Wales
Welsh Assembly Government
Cathays Parks
Cardiff
CF10 3NQ

M J A PARKER
Chief Highway Engineer
Transport Wales

Director of Engineering
The Department for Regional Development
Roads Service
Clarence Court
10-18 Adelaide Street
Belfast BT2 8GB

G W ALLISTER
Director of Engineering

VOLUME 9 NETWORK - TRAFFIC CONTROL AND COMMUNICATIONS
SECTION 4 SYSTEMS DESIGN

PART 3

TA 74/05

ANNEX A (ENGLAND AND NORTHERN IRELAND ONLY)

MOTORWAY SIGNALLING

Contents

Chapter

A1. INTRODUCTION

1. This Annex is for the specific requirements of motorway signalling in England and Northern Ireland.

A2. MOTORWAY SIGNALS

A2.1 History

1. Motorway signalling was introduced on a national basis in England in 1970 using Matrix Signals.

2. In 1991 the Department of Transport introduced the Motorway Signal Mark 2 (MS2). The Motorway Signal Mark 3 (MS3) was introduced by the HA in 1999.

3. Prior to the introduction in 1991 of the MS2 the 'standard' signal on trunk roads and trunk road was the Matrix Signal. This signal, mounted on a post normally located in the central reserve or mounted on a portal gantry for lane signalling, was designated "MS". Since the introduction of the MS2 the designation or abbreviation "MS" has led to confusion; 'message sign' and 'motorway signal' are two examples. To clarify the forerunner of the MS2 and to differentiate between uses the Post Mounted Matrix Signal normally located in the central reserve is now referenced MS1.

A2.2 Post Mounted Matrix Signals (MS1)

1. A Post Mounted Matrix Signal (MS1) comprises a matrix indicator panel and four amber lanterns mounted on a backing panel and post. The amber lanterns flash in synchronous pairs from top to bottom to draw attention to a restriction set on the sign.

2. This type of motorway signal can display temporary maximum speed advised and risk of fog ahead warnings that apply to all carriageway lanes and display lane closures for up to three lanes by the use of "wicket" symbols.

3. The MS1 illustrated in Figure 1 of TD 46 is located in the central reserve.

4. MS1 are also provided on motorway to motorway interchanges - on the offside of connecting slip roads immediately prior to the point of convergence with the main carriageway.

5. Entry slip road signals are provided in pairs at the entry to sections of motorway controlled by MS3 or gantry mounted lane signals. Entry slip road signals comprise an MS1 with red lanterns in addition to amber. The red lanterns flash in synchronous pairs from side to side and are used only when all lanes of the carriageway ahead are closed.

A2.3 Motorway Signals Mk 2 (MS2)

1. The Motorway Signals Mk 2 (MS2) is no longer current. It was replaced in 1999 by the Motorway Signal Mark 3 (MS3). The MS2 types were:

Type A1 - cantilever gantry mounted - 2 x 16 320mm character height EMS with amber lanterns;

Type A2 - cantilever gantry mounted - 2 x 12 320mm character height EMS and EMI with amber and red lanterns;

Type B1 - cantilever gantry mounted - 2 x 12 400mm character height EMS with amber lanterns;

Type B2 - cantilever gantry mounted - 2 x 16 400mm character height EMS with amber lanterns;

Type C1 - portal gantry mounted - 2 x 12 320 mm character height EMS with amber lanterns;

Type C2 - portal gantry mounted - 2 x 12 320 mm character height EMS with amber lanterns.

(Types C1 and C2 differ in mounting arrangements.)

2. The terms EMI and EMS were introduced with the MS2.

3. An Enhanced Matrix Indicator (EMI) is dimensionally larger and has more display cells than the matrix indicator used with post and portal gantry mounted signals. An EMI has 20x14 cells; a matrix indicator has 13x11. An EMI is mounted on a display board with amber and red lanterns.

4. An Enhanced Message Sign (EMS) consists of letters, numerals and other characters displayed as two rows of twelve characters (2x12) or two rows of sixteen characters (2x16) or three rows of twelve characters (3x12) or three rows of eighteen characters (3x18). Each character is formed from a 5x7 matrix of display cells. An EMS is mounted on a display board with amber lanterns and is used to display messages to provide instructions and information to drivers.

5. The "E" was dropped from EMS with the introduction of the MS3. "Message Sign" is normally written in full to avoid potential confusion between 'matrix sign', 'matrix signal', 'message sign' and 'motorway signal'.

A2.4 Motorway Signals Mk 3 (MS3)

1. The Motorway Signal Mark 3 (MS3) is available in two types.

2. The first type, MS3 (2 x 12) is a Message Sign only and consists of two lines of twelve 320mm high text characters. They are mounted on portal gantries and are used to support lane signals. They are functionally compatible with Motorway Signal Mark 2 (MS2) 2 x 12 signs. This Message Sign has two beam widths, standard and wide. Standard beam width is used for three or less lanes. Wide beam is used for four or more lanes.

3. The second type, normally mounted on a cantilever, combines Message Sign and EMI and has two variants:

a) MS3 (2 x 16) is capable of displaying either 2 x 16 nominal 400mm high characters in Message Sign only mode or 2 x 12 nominal 400mm high characters plus EMI in combined mode.

b) MS3 (3 x 18) is capable of displaying either 3 x 18 nominal 400mm high characters in Message Sign only mode or 3 x 12 nominal 400mm high characters plus EMI in combined mode.

4. A combined mode MS3 (3 x 18) displaying a 3 x 12 Message Sign plus EMI is illustrated in Figure 2.

A2.5 Gantry Mounted Lane Signals

1. A lane signal comprises a matrix indicator panel with 13 x 11 cells, four amber and four red lanterns mounted on a backing panel. A lane signal is mounted on a portal gantry, one signal over each traffic lane, where there is a need to display different restrictions over each lane. This is referred to as lane signalling and is illustrated in Figure 3 of TD 46.

2. Gantry mounted lane signals can display temporary maximum speed advised, lane divert and lane closure aspects. The red lanterns flash in synchronous pairs from side to side to indicate the closure of a lane.

3. Where lane signals are mounted on gantries a 2x12 Message Sign should only be provided in accordance with TD46.

A2.6 Supporting Structures

1. Post Mounted Matrix Signal (MS1) and entry slip road signals are mounted on posts bulk purchased by the Highways Agency (HA).

2. MS3 (2x16) and MS3 (3x18) Supporting Structuresare bulk purchased complete with the cantilever structure by the HA.

3. MS3 (2x12) Message Signs are mounted on portal gantries that are also used to support lane signals or fixed direction signs. 2x12 Message Signs are bulk purchased complete with mounting brackets by the HA. They have been designed so that equipment from any supplier will be compatible with the steelwork provided on the gantry as part of motorway construction or widening schemes.

4. Guidance on the design of the civil infrastructure, including cantilever foundations and holding down arrangements and gantry steelwork is given in TRH 1642: MS3 Infrastructure Design Guide.

5. Motorwarn signals (Scotland only) are manufactured as a free standing self contained unit.

A2.7 Communications System

1. Post Mounted Matrix Signal (MS1), entry slip road signals and lane signals can be controlled by either NMCS1 or NMCS2.

2. MS3s have a combined Message Sign and EMI driver. The two aspects are independently addressed and configured in site data. The driver is installed in an adjacent Cabinet Type 600 and controlled by an NMCS2 Standard Transponder via the standard RS485 communications circuit.

3. MS3 equipment is controlled from a Control Centre equipped with an NMCS2 Instation and Message Sign Subsystem (MSS).

4. In Control Centre areas equipped with NMCS2 without the MSS, or with NMCS1, the EMI aspects are controlled by an NMCS2 Transponder, or NMCS1 21-bit Transponder, via the standard RS485 communications circuit. The Message Sign aspects should be controlled by a Stand Alone Controller (SAC)

that operates independently of NMCS2 over a separate communications circuit.

5. Guidance on the design of the Communications System, including the facilities for control using NMCS2 and the SAC, is given in TRH 1642.

A3. MOTORWAY SIGNALLING SCHEMES

A3.1 General

1. Standards of provision for motorway signals are defined in TD 46. TD 46 supersedes the motorway signalling parts of TD 18/85.

A3.2 Signal Sequencing

1. Due to the high vehicle speeds and large volumes of traffic on motorways, it is essential that motorists are not instructed to make sudden changes in speed or course. A 30mph speed reduction between signals is considered safe. Therefore a lead-in sequence is set upstream of the restriction if it is below 40mph. For example, where a 30mph speed restriction is required the signal upstream of the restriction would be set to 50mph. This is known as longitudinal space sequencing.

2. In addition to space sequences, time sequences are used to step down to low speed restrictions. This is to avoid the sudden imposition of speed restrictions on traffic. Hence, if the operator requests a 20mph restriction the computer will normally set the signals at 40 for five seconds before stepping to 30 and then to 20 after a further five seconds.

3. In order to discourage overtaking on the inside, if a speed restriction is set on an outer lane at a lane-signalled site, the same, or lower, speed restriction is set on all inner lanes. This is known as transverse space sequencing.

4. The highest speed that can be displayed is 10mph below the permanent speed restriction for that site; therefore the maximum speed that can be displayed on a motorway signal is 60mph.

5. The Central Processor (NMCS1) or Signal Subsystem (NMCS2) calculates the required longitudinal, transverse space and time sequences from the signal setting instruction given by the operator in the control centre and applies them automatically.

6. In order to satisfy the requirements for signal sequencing a number of signal sites should be provided within a signalling scheme. Careful consideration should be given to the signal sequencing that can be achieved at the transition from carriageway to lane signals and vice versa.

7. Unless special Regulations have been made the signal sequencing terms ‘speed restriction’, ‘restriction’ and ‘speed reduction’ relate to the temporary maximum speed advised using the signs prescribed as diagram 6001 to the Traffic Signs Regulations and General Directions 2002 (SI 2002 No 3113).

A3.3 Post Mounted Matrix Signals (MS1)

1. MS1 signals shall be provided and located in accordance with TD 46.

2. When designing an MS1signalling scheme the designer should first position signals at junctions and then consider the locations for signals between junctions. The location of signals with respect to junctions may have an effect on the spacing of other signals.

3. Central reserve MS1 should not be sited within 300m of a change in the number of lanes.

4. The nominal site for central reserve MS1 at junctions is 300m downstream of the end of the entry slip road. When this position is not achievable an alternative site should be sought. Preferably this should be downstream of the initial site, however a site up to 100m upstream of the nominal site may be acceptable.

5. Since the post will normally carry signals for both carriageways, consideration should also be given to the signal position for the other carriageway.

6. Where two junctions are very close together it may be necessary to plan their signals as an entity and to omit some signals in between.

Signals at Interchanges

7. Additional MS1 are provided at interchanges on the approaches to all merges. Immediately prior to a merge two signals should be provided, one on the connecting slip road and one on the main carriageway. The signal on the main carriageway may be an MS2 or gantry mounted lane signals. These signals are also referred to as Speed Equalisation Signals.

8. Each signal should be mounted on a post on the right hand verge or central reserve as appropriate.

9. Merge signals should be omitted when they are less than 500m downstream of the previous diverge.

10. Within interchanges it is possible that more than one set of signals will have the same motorway address. Where this situation occurs early advice from the Highways Agency should be sought.

A3.4 Gantry Mounted Lane Signals

1. Gantry mounted lane signals shall be provided and located in accordance with TD 46. TD46 Drawings 1 to 5 show sign and signal gantry locations for various situations.

2. Where gantries are installed and future widening to 4 or more lanes is envisaged, and land is available, consideration should be given to either constructing gantries, which will accommodate the widened road, or providing bases for gantries over the widened road.

3. Where a Message Sign is provided on a lane signalling gantry the Message Sign should not be enabled to set driver information legends. This should be configured in the site data prior to commissioning the sign.

4. Gantries at junctions and interchanges may also be used for mounting fixed direction signs. The location of gantries should therefore be considered for both purposes, hence the one mile, half mile, final, supplementary and confirmatory gantry positions.

A3.5 Motorway Signals Mk 3

1. Motorway Signals Mark 3 (MS3) shall be provided and located in accordance with TD 46. TD46 Drawing 6 shows a scheme with MS3 and verge mounted Advance Direction Signs.

2. When designing a MS3 signalling scheme the designer should first position signals at junctions and then look at the locations for signals between junctions. The location of signals with respect to junctions may have an effect on the spacing of other signals.

3. The nominal site for MS3 at junctions is 300m downstream from junction and Motorway Service Area entry slip road merges. Where this 300m optimum position cannot be achieved consideration should be given to increasing up to 400m before reducing below 300m. The MS3 should not be closer than 200m to the merge point.

4. Where the distance between junctions does not allow for the provision of a minimum of two MS3 at 1,500m (+0%, -20%) spacing consideration should be given to using gantry mounted lane signals. The spacing of gantry mounted lane signals is 1,000m (+0%, -20%).

6. At junction approaches without gantry mounted lane signals MS3 mounted on cantilevers should be provided 300m in advance of the one mile and half mile verge mounted Advance Direction Signs (ADS). Where this 300m optimum position cannot be achieved consideration should be given to increasing up to 400m before reducing below 300m. The downstream MS3 should not be closer than 200m to either the upstream or downstream ADS.

6. At strategic junction approaches with gantry mounted lane signals on a two or three lane carriageway, MS3 (3x18) mounted on cantilever should be provided 300m in advance of the one mile and half mile gantry mounted ADS. Where this 300m minimum position cannot be achieved consideration should be given to increasing up to 400m.

7. At strategic junction approaches with gantry mounted lane signals on a carriageway with 4 or more lanes MS3 (3x18) mounted on portal gantries should be provided 300m in advance of the one mile and half mile gantry mounted ADS. Where this 300m minimum position cannot be achieved consideration should be given to increasing up to 400m.

8. The intra junction MS3 located 100m (+0%, -20%) from the back of the diverge nose enables a ‘closure of all lanes ahead’ aspect to be displayed.

9. A second intra junction MS3 is required if the distance from the nose MS3 and the first MS3 from the junction merge exceeds 1,200m.

A3.6 Entry Slip Road Signals

1. Entry slip road signals are provided at the entry points to a motorway where there is a need to close the slip road and prevent vehicles joining the motorway.

2. Entry slip road signals are provided under the following circumstances:

(i) where gantry mounted motorway signalling is provided at junctions with the facility to divert traffic from the motorway;

(ii) when cantilever MS3 are provided at the junction diverge prior to the entry slip with lane closure and diversion facilities;

(iii) at combined motorway to motorway to all-purpose road junctions, when there are facilities for diverting traffic from one or more of the motorways.

3. When entry slip road signals are used they should be provided in pairs with a signal sited in each verge, nearside and offside. The signals shall be capable of displaying the aspects shown in diagram 6032.1 in the Traffic Signs Regulations and General Directions 2002 (SI 2002 No 3113).

4. They should be sited to give maximum warning to approaching motorists in order to avoid potentially dangerous vehicle manoeuvres close to the entry slip road.

5. The signals should be sited so that they do not obstruct or are not obstructed by any other motorway signs. If necessary an extra long post (Type 75) can be used. This will mount a signal 1m higher than normal. These posts are manufactured individually to order and may be subject to protracted delivery times. An extra long connector (9900 series) is also required when using a post Type 75.

A3.7 Signals at the Start of a Motorway

1. Where an all purpose road feeds directly into a motorway gantry mounted lane signals shall be provided:

(i) where the road merges with the motorway as a slip road the gantry is provided prior to the point where the two carriageways merge. See TD46 Drawing 7;

(ii) where the road ends and becomes the motorway the gantry is provided immediately after the start of the motorway. See TD46 Drawing 7.

2. An additional gantry will be required in advance of the start of motorway except where the speed limit of the approach road is less than 40mph. This gantry will also be used for mounting direction signs and its location will be dictated by signing requirements. Special site approval will be required before signals may be sited on such a gantry. Where the approach road is a high speed road more than one additional gantry may be required.

A3.8 Signals at Exit Slip Roads

1. Lane signalling shall only be provided on exit slip roads in the following situations:

(i) at a Motorway - Motorway interchange;

(ii) at a junction where there is a loss of lane, consideration should be given to providing lane signals over the slip road. The particular signalling requirements of the scheme and the layout of the slip road shall be taken into account. Signalling shall be considered on a scheme specific basis.

A3.9 Signals at Motorway Service Areas

1. Motorway Service Areas located on a motorway have the characteristics of a normal junction except for the facility to divert traffic off the main line. Consequently:

(i) signalling provision for traffic leaving the motorway at a Motorway Service Area is not required;

(ii) entry slip road signals are required at the entry points to a motorway from a Motorway Service Area.

A4. SIGNAL SITING

A4.1 General

1. When the provision of signals is being considered each carriageway should be assessed individually. For example, it may be appropriate to provide Post Mounted Matrix Signals (MS1) on one carriageway and Motorway Signals Mk 3 (MS3) on the other.

2. Motorway signals should not be positioned within 300m downstream of a change in the number of carriageway lanes between junctions.

3. Post mounted signals installed in pairs on a common post can be installed offset to each other, if required. The offset signal arrangement is achieved by using a special signal mounting bracket. This is used to counteract the effects of local obstructions and in other situations where increased offset of the signal towards the carriageway may be required.

A4.2 Environmental Considerations

1. The location of structures used for mounting signals, either gantries or cantilevers, should be assessed for visual impact.

2. For new motorways, consideration of the type, location and degree of visual intrusion, caused by signal structures, should be included in the Environmental Assessment under landscape effects.

3. Consideration should be given to the design and location of structures to take account of the local setting in terms of landscape or townscape character, conservation designations such as National Parks and special landscape areas.

A4.3 Signal Visibility

General

1. Motorway signals are designed to meet the special requirements of motorways, good long range visibility for high speed vehicles, good penetration through fog and spray and a high level of illumination to overcome bright low level sunlight. All motorway signals have amber lanterns that are designed to be visible at 500m.

2. Post Mounted Matrix Signals (MS1) and Gantry Mounted Lane Signals are designed to be legible at a minimum distance of 200m.

3. Enhanced Matrix Indicators (EMI) are designed to be legible at 350m.

4. Motorway Signals Mark 3 (MS3) with 400mm nominal character heights are designed to be legible at 250m.

5. Message Signs with 320mm nominal character heights are designed to be legible at 200m.

6. Signals should be sited to provide continuous visibility for a distance of 500m. This may not always be possible. Table A4.3a gives details of minimum and desirable sight lines.

7. The horizontal alignment of a motorway should be taken into consideration when positioning gantries for lane signalling. Parallax problems may occur due to the curvature of the road – signals may appear to be over a different lane when viewed from a distance.

Signal Type	Sight Line (m)	
	Minimum	Desirable
MS1	300	500
EMI	350	500
Message Sign 400mm	350	500
Message Sign 320mm	300	500

Table A4.3a Signal Visibility Requirements

A4.4 Signal Positions

Allowance for Structures

1. Consideration should be given to the position of signals to ensure that bridges or other structures do not obstruct visibility.

2. Minimum distances for the siting of signals downstream of bridges are given as a guide in Table A4.4a. The precise distances will depend on the radius

of curvature and the presence of other local obstructions.

Allowance for Lighting Columns

3. Care must be taken when locating MS1 in a central reservation that also contains motorway lighting. With a lighting column spacing of approximately 35m it is usually satisfactory to position the signal post mid-way between columns. On right hand curves it is desirable to offset the MS1 towards the next lighting column downstream. The degree of offset will depend on the radius of the curve. It will rarely be satisfactory to leave less than 10m between the MS1 and the next lighting column downstream, since this is the absolute minimum likely to be acceptable for the opposing approach (which will usually be on a left hand curve). Occasionally, it may be necessary to use separate MS1s individually sited for the two carriageways but this should be avoided where possible in consideration of additional cost.

4. Where cantilever mounted signals/signs are to be installed and the motorway lighting is in the verge care should be taken to place signals at least one column length away from the nearest lighting column. This is to prevent damage being sustained by the signal in the event of the lighting column being knocked down by a vehicle. The lantern height will usually be 10m or greater and therefore will not interfere with signal visibility.

Other Equipment

5. Care should be taken when siting signals to ensure that they do not cause obstruction to signs and fog detection equipment. Similarly, gantry and cantilever structures should not adversely affect the field of vision of CCTV cameras.

6. It is also important to ensure that traffic signs and CCTV camera sites do not obscure signals.

Stopping Sight Distances

8. When positioning signals consideration should be given to stopping sight distance (SSD) and the potential obstruction to SSD by signal mounting structures. See TD9.

Location	Road Geometry	Minimum Distance
Gantry/Cantilever mounted signals downstream of 5.5m clearance bridge	Level Road	300m
	Gradient	200m-400m dependent on gradient
Post mounted Matrix Signal downstream of central reservation bridge pier	Approach on right hand curve	450m
	Approach on straight curve	300m
	Approach on left hand curve	200m

Table A4.4a Minimum distances for siting signals downstream of bridge structures

A4.5 Other Siting Considerations

1. Further design considerations for siting of signals include:

(i) proximity of power supplies;

(ii) available space for communications and power cabinets;

(iii) access for maintenance;

(iv) environmental impact including proximity to residential/amenity area.

A4.6 Design Procedure

1. The design of a signalling scheme is an iterative process. The stages listed below should be followed:

(i) position all signals in relation to the junction merge points;

(ii) position gantry signals (where appropriate) on the approaches to junctions;

(iii) position any gantry signals (where appropriate) within the junctions;

(iv) position all carriageway signals starting upstream from diverge to merge;

(v) review all signal locations with respect to other facilities such as bridges, ducts, signs, lighting etc.

2. It is important to check the effect of the scheme design on existing signals in adjacent sections of motorway. The boundaries between carriageway and lane signalling cannot always coincide with the limits of the scheme if safe signal sequencing is to be achieved. The Highways Agency should be advised at an early stage of any alterations to signals outside the scheme boundaries that may be necessary.

3. Another important detail that should not be overlooked is the capacity and/or arrangement of the communications infrastructure within the Control Office Area (COA). Further details can be found in TA 75: Motorway Transmission and TA 76: Motorway Control Offices.

A4.7 Link Roads

1. On schemes where link roads (formerly Collector-Distributor roads) are proposed early advice should be sought from the Highways Agency regarding the location of signals.

2. It is essential that signals be positioned such that motorists are readily able to identify which signals apply to which carriageway. It may be difficult to provide safe signal sequencing.

A5. SIGNAL INFRASTRUCTURE

A5.1 Control Systems

Post Mounted Matrix Signals (MS1)

1. Post Mounted Matrix Signal (MS1) and gantry lane signalling schemes can be controlled by either NMCS1 or NMCS2. NMCS1 schemes are described in TA 72: National Motorway Communications Systems.

Motorway Signals Mk 2 Schemes and Gantry Signalling with Message Signs Schemes

2. Motorway Signal Mark 2 (MS2) signalling schemes and gantry signalling with Message Signs schemes can be controlled by either NMCS2 or an upgraded NMCS1. The method of control will be dependent on the type and configuration of the NMCS within the Control Centre area. Essentially there are three types of control:

(i) NMCS2 with Message Sign Subsystem (MSS);

(ii) NMCS2 with Message Sign Stand Alone Control (SAC);

(iii) NMCS1 with an NMCS2 21-bit Transponder for EMI and with Message Sign SAC.

Motorway Signals Mk 3 Schemes and Gantry Signalling with Message Signs Schemes

3. The control systems are described in detail in TRH 1642 - MS3 Infrastructure Design Guide.

A5.2 Civil Works

Infrastructure

1. Dedicated NMCS2 Infrastructure is normally provided for the operation and control of motorway signalling systems. Where new signalling schemes are introduced within existing sections of motorway communications and electrical works will include modifications to existing cabling and equipment to integrate the new signalling systems.

Cabling and Power Considerations

2. Power and communications cables for motorway signals are installed in ducts situated in the motorway verges. Where cables are required to cross the carriageway they are located in cable ducts buried below the carriageway. Transverse ducts are usually provided at nominal 500m intervals along the carriageway extending to both the central reserve and the opposite verge of the motorway.

3. In motorway signalling upgrading schemes it may be either cost effective or necessary to install new transverse cable ducts below the carriageway to reach individual motorway signal sites.

Post Mounted Matrix Signals and Gantry Mounted Lane Signals

4. Typical sites will comprise:

(i) MS1 and entry slip road signals site will comprise a Post 75E mounted on a plinth 610 and cast into a concrete foundation. For gantry mounted lane signals – a gantry.

(ii) Communications Cabinet Type 600 (at a Standard Transponder site) and Power Isolation Cabinet Type 609 with associated cabling and ducts.

(iii) Vehicle Restraint System.

(iv) Paving, handrails and retaining walls as required by site conditions.

Motorway Signals Mk 3

5. The Infrastructure for a typical MS3 site comprises:

(i) A foundation and plinth fitted with a standard holding down arrangement to support a cantilever structure and MS3.

(ii) Communications Cabinet Type 600 and Power Isolation Cabinet Type 609 with associated cabling and ducts.

(iii) Vehicle Restraint System.

(iv) Paving, handrails and retaining walls as required by site conditions.

6. Design requirements and guidance for the MS3 and Message Sign Infrastructure are detailed in TRH 1642: MS3 Infrastructure Design Guide.

A5.3 Configuration P and F

1. Post Mounted Matrix Signals (MS1) and Gantry Mounted Lane Signals have previously been cabled to their control equipment in one of two configurations, P or F. Highway Construction Detail MCX 0157 shows the arrangements for both configurations. Configuration P equipment is no longer specified. New schemes should adopt the configurations shown on Highway Construction Detail MCX 1022.

2. Where the P type configuration is being re-used, equipment can be provided by the Highways Agency to support it. Design agents should consult the Highways Agency for advice.

A6. NMCS2 SIGNAL EQUIPMENT

A6.1 Equipment Lists

1. The following Tables A6.1a-A6.1e list Post Mounted Matrix Signals (MS1), Gantry Mounted Lane Signals, Motorway Signals Mk 3 (MS3) and Message Sign equipment for each outstation site and may be used for guidance in the completion of MCH 1286.

2. Reference should also be made to NMCS Installation Drawings, in particular Highway Construction Details MCX 0157, MCX 0590, MCX 0591 and MCX 1022 that show equipment configuration for MS3, Message Sign, Gantry Mounted Lane Signals and Post Mounted Matrix Signal outstation sites.

A6.2 Signal Equipment

1. NMCS2 uses a standard range of purpose designed equipment for the operation and monitoring of signalling and signing equipment. For signals controlled by a Stand Alone Controller (SAC) a range of non-standard equipment will also be required:

(i) Distributor Type 901: provides power isolation facilities for gantry and cantilever mounted motorway signals.

(ii) DLCB 9902: used in NMCS2 post mounted matrix signals for termination of signal cables and connection to the Signal Driver, and termination of the mains input cable and connection to the Signal Driver Power Unit.

(iii) DLCB 9903/9904: used in NMCS2 gantry mounted motorway lane signals for termination of the signal cables and connection to the Signal Driver.

(iv) Indicator Power Drive Unit (IPDU): Signal indicator power distribution unit.

(v) Flexible Connectors: used for connecting equipment on gantries. Connectors are available in 4m, 8m and 20m lengths. 20m connectors are for use on double span gantries.

Equipment	Signal Arrangement		
	MS1 Carriageway Single Site	MS1 Carriageway Double Site	Entry Slip (Each Signal)
Indicator 407 (3 lane)/409 (2 lane)	1	2	1
Post 75E – see Note 1	1	1	1
X Frame	1	2	1
Lanterns Type 73 (Amber)	4	8	4
Lanterns Type 82 (Red)	-	-	4
Signal Driver	1(9324)	2(9324)	1(9324)
Signal Power Unit	1(9352)	2(9352)	1(9352)
DLCB 9902 – see Note 1	1	1	1
Power Cabinet Type 609 – see Note 1	1	1	1
Communications Cable – see Note 1	Cable length dependent on site layout		
Power Cable 10 sq mm 3 core – see Note 1	Cable length dependent on site layout		
Notes – Installed by Infrastructure Contractor. All other equipment normally installed by the Systems Contractor.			

Table A6.1a Post Mounted Matrix Signals – Type 400 Series

Equipment		Signal Arrangement				
		2 Lane	3 Lane	4 Lane	5 Lane	6 Lane
Indicator 421		2	3	4	5	6
X Frame		2	3	4	5	6
Lanterns Type 73 (Amber)		8	12	16	20	24
Lanterns Type 82 (Red)		8	12	16	20	24
Signal Driver 9324		2	3	4	5	6
Signal Power Unit	9352	1	-	2	1	-
	9353	-	1	-	1	2
Distributor Type 901 – see Note 1		1	1	2	2	2
DLCB – see Note 1	9903	1	1	1	1	1
	9904	-	-	1	1	2
Communications Cable – see Note 1		Cable length dependent on site layout				
Power Cable 10 sq mm 3 Core – see Note 1		Cable length dependent on site layout				
Notes - Installed by Infrastructure Contractor. All other equipment normally installed by the Systems Contractor. The signal driver for Type 9421 indicators are integral with the indicator.						

Table A6.1b Gantry Mounted Lane Signals – Type 421

Outstation Equipment	Signal Arrangement
	MS3
Cantilever Structure	1
Base Plate, Holding Down Studs and Nuts	1 Set
MS3 Mounting Brackets	1 Set
MS3 (2 x 16) OR MS3 (3 x 18)	1
Combined Message Sign/EMI Driver	Integral with signal enclosure
DLCB 9905	1
Distributor Type 901	1
MS3 Cabinet Type 600 – see Note 1	1
Power Cabinet Type 609 – see Note 1	1
Communications Cable	Approximately 60m
Power Cable 10 sq mm 3 core	Approximately 60m
Notes – Installed by Infrastructure Contractor. All other equipment normally installed by MS3 Contractor.	

Table A6.1c Motorway Signal Mark 3 – 2 x 16 x 400mm nominal character heights and 3 x 18 x 400mm nominal character heights

Outstation Equipment	Sign Arrangement
	Message Sign
Gantry Additional Steelwork (*)	1
Mounting Brackets	1
Message Sign 2 x 12 x 320mm	1
Message Sign Driver	Integral with sign enclosure
DLCB 9905 (*)	1
Distributor Type 901 (*)	1
MS3/Message Sign Cabinet Type 600 (*)	1
Power Cabinet Type 609 (*)	1
Communications Cable 2 Pair (*)	Approximately 30m
Power Cable 10 sq mm 3 core (*)	Approximately 30m
Notes – (*) = Installed by Infrastructure Contractor. All other equipment normally installed by Message Sign Contractor.	

Table A6.1d Message Sign – 2 x 12 x 320mm nominal character heights

A7. NMCS1 SIGNAL EQUIPMENT

A7.1 Motorway Signal Equipment

Distributors

1. A Distributor Type 902 is required for each post-mounted controller and a Distributor Type 901 and 903 are required for each gantry-mounted controller.

2. The Distributor Type 902 provides both communications and mains power facilities for a signal controller driving one or two signals. It includes an impact switch to trip the incoming mains supply if a vehicle hits the post. The distributor is not weatherproof and is therefore installed within the signal post.

3. Distributor Types 901 and 903 provide power and communications distribution facilities respectively for gantry-mounted signals. The units are weatherproof and cater for a signal controller driving up to three signals.

Signal Controllers

4. Signal controllers are of two sizes, the smaller unit (which caters for one or two posts) and the gantry-mounted signal unit. When the smaller unit is used, it is frequently equipped only with the printed circuit boards required for the site at which it is being installed. Gantry fittings will accommodate either size of controller.

5. All signal controllers have a type number in the 900 series. The second digit indicates the number of signals to be driven; the third digit indicates the number of signals with the red stop facility. The usual types of controller are as follows:

(i) Controller 910 – to drive Post Mounted Matrix Signal (MS1) Type 407 or 409.

(ii) Controller 920 – to drive two Post Mounted Matrix Signals (MS1) Type 407 or 409.

(iii) Controller 911 – to drive one post mounted entry slip road signal Type 409W or one gantry mounted lane signal Type 421.

(iv) Controller 922 – to drive two gantry mounted lane signals Type 421.

(v) Controller 933 – to drive three gantry mounted lane signals Type 421.

Signal Switches

6. There are two types of signal switch designated 904 and 905. The latter is used for signals that require additional facilities for their red lanterns. Although both types of switch appear similar, the pin orientation within their connector plugs is different. Therefore, a signal switch cannot be connected to the wrong signal type.

Indicator

7. The matrix indicator types used for NMCS1 are identical to those used for NMCS2.

21-bit Transponder

8. This allows NMCS2 signal equipment to be used in an NMCS1 CO area.

Further Information

9. Further information on NMCS1 design is contained in TA 72: National Motorway Communications Systems.

A8. GLOSSARY

Advance Direction Sign (ADS)

Static signs used to provide directional information in advance of a junction. May be mounted on a gantry or supported on posts in the verge.

Cabinet Type 600

Standard motorway equipment cabinet, for use on motorway verges, to house equipment such as Standard Transponders, MIDAS Transponders, Responders, Sector Interfaces and Sector Blocks. Also used as a Marshalling Cabinet.

Cabinet Type 609

Standard motorway cable connection cabinet, for use on motorway verges, to house connection boxes for data, and also used to house (separately) electrical power supply distribution and isolation equipment.

Cantilever

An overhead structure which extends from the verge. It has only one leg which is located in the verge.

Data Link Connection Box (DLCB) 9902

Data Link Connection Box 9902 provides electrical and data distribution to signals and fog detectors at posts. An accident impact breaker is included.

Data Link Connection Box (DLCB) 9903

Data Link Connection Box 9903 provides data distribution to signals on gantries and signs as required.

Data Link Connection Box (DLCB) 9904

Data Link Connection Box 9904 is used to extend data distribution in conjunction with DLCB 9903.

Distributor Type 901

Electrical distribution switch for use with signals on gantries.

Distributor Type 902

Distributor 902 provides power and data distribution for post mounted signals in NMCS1 systems.

Distributor Type 903

Distributor 903 provides data distribution for gantry mounted signals in NMCS1 systems.

Gantry

An overhead structure that spans a carriageway having a leg in the verge and a leg in the central reserve (may span more than one carriageway and have more than two legs). Used to support signals and/or signs.

Indicator Power Drive Unit (IPDU)

An NMCS2 unit local to a signal.

Instation

Those parts of the National Motorway Communications System (NMCS) which are normally located within the Control Centre. See also Outstation. Often referred to as the building which contains the control centre and provides an office type environment for equipment sited at the instation.

Link Road

A road which runs parallel to a motorway and forms a link between adjacent junctions. It allows local traffic to travel between junctions without interrupting the flow on the motorway. Link roads were formerly known as Collector-Distributors.

Message Sign Subsystem (MSS)

A Control Office Base System (COBS) Subsystem that controls message signs.

National Motorway Communications System 1 (NMCS1)

A combined signalling and telephone system controlled from Regional and National central processors, installed up to 1988.

National Motorway Communications System 2 (NMCS2)

A system using locally based distributed processing to control telephones and signals, installed from 1988.

RS485

A data protocol (EIA RS485) and practice adopted for use by NMCS2 between the Standard Transponder and motorway devices.

The RS485 Multidrop Link is the lowest hierarchical level of transmission in an NMCS2 data system and provides the means, parameters and protocol of communication between Transponders and motorway devices. It allows the Transponder to control several devices at once or individual devices. However, individual devices can only transmit to the Transponder.

Transmission is half duplex, ie transmission in only one direction at once. Each link caters for up to 30 motorway devices. Each message comprises 5 characters of 8 data, 1 parity, 1 start and 1 stop bits. The characters represent address, command, data byte 1, data byte 2 and longitudinal parity.

Signal Controller

An outstation device local to a signal dedicated to controlling a signal.

Signal Driver

An outstation dedicated to controlling a matrix signal.

Signal Driver Power Unit

The electrical distribution unit that provides power to a Signal Driver.

Signal Subsystem

A Control Office Base System (COBS) subsystem that controls motorway signals. The Signal Subsystem is always present in a Control Office area.

Signal Switch

An NMCS1 unit local to a motorway signal that controls the operation of the signal and provides monitoring and test facilities.

Stand Alone Control (SAC)

A non NMCS2 system used to control and update Message Signs.

Stand Alone Controller (SAC)

The operator interface with the Message Signs in a Stand Alone Control system.

Standard Transponder

Standard Transponder is at the lowest hierarchical level within the Control Centre Area. It interfaces to Local Communications Controller/HDLC links and provides a star point on the RS485 local links. It also provides some of the signal sub-system functions and a post box service to other sub-systems. It controls up to 120 motorway devices.

21bit Transponder

This item of equipment is a derivative of the Standard Transponder (ST)Standard Transponder (ST), modified to allow communication with an NMCS1 Central Processor, to enable control of NMCS2 signals in a NMCS1 Control Office (CO)Control Office (CO) Area. The 21-bit Transponder translates and interprets messages received from NMCS1 and controls the signal accordingly. The term 21-bit is derived from the NMCS1 21 bit word length.

Variable Message Sign (VMS)

A sign that can display a number of defined legends or messages.

Wicket

MS1s and EMIs use wickets to indicate the closure of one or more lanes. A vertical line indicates that a lane is open; a T indicates that a lane is closed. On a three lane motorway the signal resembles a cricket wicket.

A9. REFERENCES

Statutory Instruments. Available from the Stationery Office www.tso.co.uk/bookshop

TSRGD – The Traffic Signs Regulations and General Directions 2002 (SI 2002 No 3113)

The Traffic Signs Regulations (Northern Ireland) 1997 – (SR 1997 No 386)

Design Manual for Roads and Bridges documents. Available from the Stationery Office www.tso.co.uk/bookshop

TD 9 – Highway Link Design (DMRB 6.1.1)

TD 18/85 – Criteria for the use of gantries for traffic signs and matrix traffic signals on trunk roads and trunk road motorways

TD 46 – Motorway Signalling (DMRB 9.1.1)

TA 72 – National Motorway Communications System (NMCS) (DMRB 9.4.1)

TA 75 – Motorway Transmission Design (DMRB 9.4.4)

TA 76 – Motorway Control Offices (DMRB 9.4.5)

TA 83 – Gude to the Use of Variable Message Signs for Strategic Traffic Management on Trunk Roads and Trunk Road Motorways (DMRB 9.4.6)

Manual of Contract Documents for Highway Works documents. Available from the Stationery Office www.tso.co.uk/bookshop

Highway Construction Details – MCX Series (MCHW 3.3)

tss Plans Registry documents. Available from www.tssplansregistry.org

MCH 1286 – Request for financial approval (Standard and Non-Standard Schemes) and Bulk Purchase Equipment Order

TRH 1642 – MS3 Infrastructure Design Guide