

TOPAS

Traffic Open Products and Specifications

TOPAS 2540A

Performance Specification for Portable & Temporary Traffic Signalling Systems for Temporary Traffic Management

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TOPAS 2540A

PORTABLE & TEMPORARY TRAFFIC SIGNALLING SYSTEMS FOR TEMPORARY TRAFFIC MANAGEMENT

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1. INTRODUCTION

- 1.1 This specification covers the requirements for portable & temporary traffic signal controller equipment incorporating pedestrian facilities for operation at road works & Haul Route Crossings on roads other than motorways.
- 1.2 In this specification “road works” are defined as any works or temporary restrictions which cause partial or total obstruction of any road or highway. Examples may include highway improvement schemes, excavations, structural or maintenance works of any kind, street works or any other work executed on or near the highway together with the necessary working space, safety zones, space required for the storage of any materials, the construction of any temporary structures and the operation of any constructional plant required for the execution of such work, including associated surveys and inspections.
- 1.3 “Road” in England and Wales is defined as ‘any highway and any other road to which the public has access and includes bridges over which a road passes’ (RTA 1988 sect 192(1)). In Scotland, the definition is extended to include any way over which the public have a right of passage (R(S)A 1984 sect 151(1)).
- 1.4 TOPAS specifications are explicitly purchasing specifications and compliance with them is not mandatory.
- 1.5 However Local and other Purchasing Authorities may typically require that equipment purchased complies with TOPAS specifications and is TOPAS registered.
- 1.5 Manufacturers may register products as being compliant with this specification, using the process defined in TOPAS 0600.
- 1.6 TOPAS registration requires manufacturers to submit a Technical File to an appropriate Technical Assessor to aid compliance verification. The content requirement for the Technical File is defined in Appendix Z of this specification.
- 1.7 Within this specification, “The product” shall mean all components necessary to provide a complete operational unit meeting the requirements of this specification and the common requirements defined in TOPAS 0600.

Implementation

- 1.8 This standard will be immediately implemented from the date of issue for all new TOPAS Registrations.
- 1.9 Approvals issued against previous standards will remain valid. Retrospective action against this standard is not mandatory.

Product Definition

- 1.10 'Portable' light signal control equipment uses light signals prescribed in UK Statutory Instrument No.362 Traffic Signs Regulations and General Directions 2016 which are intended for the control of vehicular traffic and pedestrians for relatively short periods of time.
- 1.11 'Portable' light signals are normally mounted on a post fixed to a tripod or wheeled base unit can be easily moved by one operative.
- 1.12 'Temporary' traffic signal control equipment uses full size light signals and is capable of being used in any control configuration implemented by permanently installed light signals including signalised crossing facilities.
- 1.13 'Temporary' light signals are mounted on a post in a container that cannot be moved without the use of mechanical handling equipment.

Glossary of Terms and Abbreviations

- 1.14 A comprehensive glossary of terms and abbreviations may be found in the Institute of Highways Engineers guidance note "Traffic Control and Information systems".

TOPAS Terms are defined in TOPAS 0600 and TOPAS 0601.

2. COMMON REQUIREMENTS

General Requirements

2.1 These requirements are for both wired and wireless systems. For the purposes of wireless (radio) based systems it is assumed the design of the Product is such that the intelligence is divided into discrete distributed components. For both wired and wireless systems:

- i) The Product shall provide a robust and reliable means of fail-safe communication and provide suitable levels of security, accuracy and reliability of all data being transmitted and received.
- ii) The Product shall maintain reliable operation in all reasonably expected conditions of use and shall be unaffected by other sources of radio transmission and by screening or reflections from vehicles or buildings.
- iii) If the equipment uses wireless operation shall be able to co-exist with other services and signals in the same band without loss of performance.
- iv) The Product shall be designed to provide reliable operation for up to 300 metres between any two “system components” under all normal conditions of deployment without any detectable loss of performance.
- v) A communications monitoring facility which is independent to the signal control function shall be provided to verify the integrity of the communications system.
- vi) Any fault condition that results in lights out, may only allow Amber as the next permitted signal for traffic signals and Red Man for pedestrian signals.
- vii) Recovery from any communications fault should mitigate any impact on the road network.

Defined Terms

2.2 These requirements refer to two named components of a portable signal, namely the ‘Master’ and one or more ‘Signals’ as defined below:

Signal:	A component of the Product comprising one or more vehicle or pedestrian signal heads, usually connected to a controller.
Master:	A component of the Product that is responsible for instructing Signals as to the required signalling state.
Signal Group:	A group of signal heads that always receive identical signal light indications. A signal group can be a stage.
Controller:	A system sub-component used to deliver the control strategy in a distributed system.

Note that a portable signal may take the role of Signal or Master or both.

Core Safety Requirements

- 2.3 Under all fault conditions (including intermittent or permanent interruption of communications between the Master and Signals), the design of the Product shall ensure the specified Maximum Permitted Durations for the display of the faulty signal states shown in Table 1 are not exceeded:

Item	BS EN 12675 Definition	Class	Maximum Permitted Duration	TOPAS 2540 Non fail-safe functions
1	Green – Green Conflict	AA1	500ms	
2	Green – Yellow Conflict	AB1	500ms	
3	Yellow – Yellow Conflict	AC0		
4	Green - Red/Yellow Conflict	AD1	500ms	
5	Green - Green/Yellow Conflict	AE0		
6	Absence of any conflicting Red signal	AF0	4s	System should implement Red lamp monitoring
7	Absence for conflicting Red on specified signal heads	AG0	4s	System should implement Red lamp monitoring
8	The absence of the last conflicting Red signal	AH0		
9	Absent Red/Absent Red	AJ0		
10	National Signal Regulations (infringement)	BA0	500ms	System should check signal compliance
11	Absence of a Red signal on a specified signal group	CA1	12s	
12	Absence of the last Red signal	CB1	12s	
13	Absence of a number of Red signals	CC1	12s	
14	Absence of specified Red signals	CD0		
15	Absent signal groups, Yellow or Green signals	CE0		
16	Compliance checking	DA1	500ms	
17	Stored values of timings	FA1		
18	Time base frequency	FB0		
19	Minimum values of time settings	FC0		
20	Maximum values of time settings	FD0		
21	Duration of timings	FE0		
22	National signal sequences (infringement)	GA0		
23	Specified signal group Green to signal group green movements	GB0		
24	Specified signal start-up sequence	GC0		
25	Failure of external inputs	HA1		

Table 1

- 2.4 Occurrence of any of the following fault classes from BS EN 12675 shall be treated as a Category 1 fault: AA, AB, AD, BA, DA as per section 2.13
- 2.5 In the event that the Product design achieves compliance with this specification through use of a mechanism that temporarily holds the current aspect outputs in their last known good state (for example during a temporary loss of communications between Master and Signal), this shall be referred to in the documentation supplied by the manufacturer as a Category 2 fault and the criteria against which such a fault type is raised and cleared shall be documented.
- 2.6 The requirements relating to Category 2 faults in section 2.14 shall also be met.
- 2.7 It is not permitted to hold signals in their last known good state if that signal state endangers traffic (Classes AA, AB, AD or DA) or creates a Category 1 fault.
- and shall treat any such transition as a Category 1 fault:
- i) Lights Out to Red
 - ii) Red/amber to Red
 - iii) Green to Red
 - iv) Red to Green

Aspect Monitoring

- 2.8 Aspect monitoring facilities shall be provided. These shall be capable of detecting where aspects are disconnected, failed or illuminated when they should not be and shall be sufficient as required to test compliance with all requirements in this specification.

Prohibited Transitions

- 2.9 By design, excluding start-up sequences, a three-aspect traffic signal head shall not perform any of the following signal transitions

Timing Tolerance

- 2.10 The order of illumination for the aspects of vehicular signals shall be as follows: red, red and amber together, green, amber, red.
- i) The duration of the period when the red and amber light signals are illuminated together shall be 2 seconds with a tolerance as defined in Table 2.
 - ii) The duration of the period when the amber light signal is illuminated on its own shall be 3 seconds with a tolerance as defined in Table 2.
- 2.11 The duration of any period of vehicle red, pedestrian red or pedestrian blackout shall comply with the Phase Intergreen tolerance defined in Table 2.
- 2.12 The total timing tolerance of the controller can be considered in various categories. These tolerances shall be met at all times where communications between the Master and Signal are intermittent or lost completely.

Parameter	Range	Maximum Step Size	Tolerance
Mandatory Signal Timings			
Red/amber	2 seconds	-	A
Amber	3 seconds	-	A
Signal Timings – Working Values			
Phase Min Green	TBD	1 second	B
Phase Max Green	TBD	1 second	B
Phase Intergreen	TBD	1 second	B
Pedestrian Blackout	TBD	1 second	B

A – Tolerance \pm 250 milliseconds

B – Tolerance -250ms to +12 seconds

Table 2

Failure Modes

2.13 Category 1

All signal heads shall revert to Lights Out within 500 milliseconds following the detection of a Category 1 failure.

2.14 Category 2

- The signals shall remain in their current display condition. Any amber transitions currently in progress shall be completed, maintaining compliance with timing tolerance category A for all amber timings.
- A Category 2 fault shall not persist for more than 12 seconds. After 12 seconds a Category 1 fault shall be raised.

2.15 Manufacturers may define their own additional categories provided these are documented.

Recovery from Failures

2.16 The Product may elect to transition to Lights Out or All-Red in response to some fault conditions such as low battery alerts.

2.17 Where the Product transitions to All-Red in response to a fault, this All-Red state may be maintained for a period that shall not exceed double the maximum configured cycle time for the current signalling scheme and operating mode. If this max All-Red time expires this condition shall be treated as a Category 1 fault.

2.18 Where the Product transitions to Lights Out in response to a fault, the Product may recover back to normal operation automatically

provided the following requirements are met:

- i) Communications have been re-established with all Signals such that every Signal within the scheme has successfully communicated with the Master without error within the last 500ms.
- ii) The process of automatically restarting shall follow a standard start-up signalling sequence as detailed in Sections 2.35 to 2.39.
- iii) The Product design mitigates the risk of causing nuisance through continual failed attempts to restart.
- iv) The automatic recovery process can be demonstrated as being safe for all fault classes for which an automatic recovery would be attempted.
- v) It is not permitted to recover from a fault to Lights Out where the fault condition was initiated by a Category 1 fault resulting from a traffic state endangering traffic as defined in 2.7. These faults must be investigated and manually reset.

Restrictions

2.19 It shall not be possible to configure a signalling scheme that displays green to vehicular phases and pedestrian phases simultaneously other than where it can be demonstrated that Signals cannot be physically

moved or re-oriented by members of the public. This typically will mean that such schemes are available within Temporary signals only and not Portable signals. Frequently this provision is achieved through ensuring the Product weight exceeds that which can be lifted, moved or rotated manually without specialist lifting equipment. As a general rule, Products with a weight in excess of 250Kg can be considered as meeting this requirement.

- iv) Aspect Monitoring
- v) Prohibited Transitions
- vi) Timing Tolerance

2.22 Detailed design information is not required to be provided however the design compliance section should illustrate how the main components of the system interact to achieve compliance.

2.23 The manner in which compliance is maintained during periods where communications are intermittently lost shall be explicitly addressed.

Technical Construction File

2.20 The manufacturer should provide a unique document reference to a Technical Construction File (TCF). This shall include the following, for which the requirements are provided in 2.21 - 2.27:

- i) Details of how the design complies with key requirements in this specification.
- ii) FMEA Analysis for conditions that give rise to signal states that endanger traffic.

Design Compliance Statements

2.21 The TCF shall include a description of how the product design achieves compliance with each of the requirements in the following sections of this specification:

- iii) Core Safety Requirements (including all fault classes from Table 1)

Failure Mode & Effects Analysis (FMEA)

2.24 A detailed FMEA analysis shall be undertaken by the manufacturer and documented. The scope of this analysis shall be the fault classes listed in Table 1 as producing a "signal state which endangers traffic". The FMEA analysis shall demonstrate that for all such fault classes, the product returns to a safe signalling state within the maximum permitted duration for each fault class.

2.25 FMEA analysis shall be performed in compliance with class X1 of BS EN 50556

2.26 Analysis should consider all possible hardware fault conditions. Some example conditions for inclusion in such analysis are:

- i) An intermittent loss of communication between the Master and any one Signal.

- ii) A permanent loss of communication between the Master and any one Signal.
 - iii) An intermittent loss of communication between the Master and all Signals.
 - iv) A permanent loss of communication between the Master and all Signals.
 - v) A permanent loss of communication between the Master and a Signal which is displaying a Class AA green conflict due to a fault.
 - vi) A simultaneous permanent loss of communication between the Master and any pair of Signals, one or both of which is displaying a Class AA green conflict due to a fault.
 - vii) A permanent loss of communication between the Master and a Signal, followed shortly afterwards by loss of communication with another Signal where one or both signals are displaying a Class AA green conflict due to a fault.
 - viii) Interference that gives rise to the corruption of a communication from the Master to a Signal.
 - ix) Interference that gives rise to the corruption of a communication from a Signal to the Master.
 - x) Any software fault in the Master controller.
 - xi) Any software fault in a Signal controller.
 - xii) Any failure of the hardware or any combination of hardware components as detailed in EN50556.
- 2.27 Some Product designs provide multiple heads or aspects in a manner that share a single output from a controller (in the simplest case, aspects wired electrically in parallel). This practice has safety implications and is permitted only where FMEA analysis is provided to specifically detail how the design avoids risk of breaching the maximum permitted durations specified in Table 1. Any such use of this type of design (or similar) shall be declared within the FMEA analysis.
- ### **Red Signal Monitoring**
- 2.28 The Product shall provide functionally to monitor red vehicle signals for failure at each signal head in full intensity and at the dimmed level when fitted. Failure of the monitoring equipment shall cause a Category 1 fault.
- 2.29 In the event of all monitored red signals failing on an approach or a failure of the red signal monitor being detected, then the Product shall follow the procedure for a Category 1 fault.
- ### **Illuminate/Extinguish Signals**
- 2.30 A facility to illuminate or extinguish the signals, including any audible and tactile units, from the operators' panel, shall be provided.
- 2.31 When the signalling systems are switched on there shall be no illuminated signals shown to traffic.
- 2.32 Operating the facility to extinguish the signals shall not affect the operation of the Product. When

the signalling system illumination is restored they shall start up in accordance with the normal start-up sequence.

Initial set-up

- 2.33 On initial set-up, where the Product has independently powered signal heads relying on a communication system to provide instructions to change the signal display, in order to perform the start-up sequences, it would be necessary for the communication system to be established and verified to all signal heads before any signals are illuminated.
- 2.34 As an alternative to 2.31 and 2.33, it shall be permissible for any pedestrian signal to display red and for each traffic signal head to show a three second amber display followed by red, when its related control unit is powered up. It shall not be possible for any green signals to be displayed until all signal heads have been switched on, the communication system established and verified to all signal heads and the maximum preset all-red period has elapsed.

Signal Start up Sequence

- 2.35 Where Traffic Control, Traffic Control with Pedestrian, stand-alone Pedestrian or Haul Route facilities are provided within the same controller, then each facility shall function independently of the other with regard to start up requirements.
- 2.36 When signals are switched on, the Product shall initially display a red pedestrian signal to pedestrians (where present) and no signal to vehicles.

2.37 The Product shall drive each stage to automatically display a 3 second amber vehicle signal followed by red, in cyclic order up to the selectable final stage which shall display a green signal after an all-red period equal to the longest all-red period pre-set in the controller.

2.38 On display of the green signal to vehicles, stored demands for pedestrians and all vehicle stages shall be inserted and the Product shall commence normal vehicle actuated (VA) operation unless or until Manual or Fixed Time (FT) is selected.

2.39 When 'Manual Control Mode' is selected, the final stage shall not display green but move through a 3-second amber to red and await a manual command. The controller shall not move to a manually selected stage until the signals have been at all-red for at least the maximum pre-set all-red period.

Fault Recording (Optional)

- 2.40 Fault recording facilities shall be provided in the controller in accordance with BS EN 12675:2000 5.4 Storage of Faults.
- 2.41 The fault log shall record the date and time of fault clearances. The fault log shall have, as a minimum, the capacity to record 255 events

Reliability

2.42 The controller shall be designed to have a minimum in-service life of 7 years with suitable maintenance.

Electrical Requirements

- 2.43 The Product shall operate using an Extra Low Voltage or Reduced Low Voltage power supply as defined in BS 7671 Requirements for Electrical Installations.
- 2.44 All wiring, termination, earthing and labelling shall be in accordance with BS 7671.
- 2.45 Tripod based Products shall be capable of operating for a minimum continuous period of 24 hours under full-load conditions in low temperatures without attention.

Equipment Housing

- 2.46 The Product in its housing shall meet the requirements of BS 7987 to the same environmental performance classes as defined in TOPAS 2130.
- 2.47 Any covers, doors, flaps, or similar allowing access to controls, circuits or live parts when opened shall meet the IP ratings of BS 7987.
- 2.48 Safety critical timing adjustments to the Product shall only be accessible via the main housing door (see Control Facilities and Indications).

Operator Facilities

- 2.49 The Product's main panel shall only be accessible by authorised personnel.
- 2.50 A means shall be provided to configure the Product on set up, monitor operational values to confirm correct operation and provide diagnostic information for maintenance and fault repair.

Control Facilities and Indications

- 2.51 Control facilities which shall only be accessible via the main housing door shall include the selection of:
 - i) the vehicular maximum green running period;
 - ii) the all-red period to follow each stage.

And where pedestrian facilities exist;

 - iii) the pedestrian to vehicular stage all-red clearance period;
 - iv) the vehicular maximum green running period;
 - v) the vehicular red and pedestrian black-out period.

- 2.52 The following control facilities are also to be provided and may be used via an operator panel select mode of operation;

- 2.53 Indications shall also be provided to show each of the following:
 - i) the presence of a stored demand on each stage;
 - ii) the operation of the detector when the stage is displaying the green signal;
 - iii) the current state of each signal on each stage;
 - iv) the occurrence of a hazardous light signal display (any non-permitted combination of signal displays)
 - v) conflicting green failure;
 - vi) the occurrence of a red lamp or red lamp monitor failure;

- vii) Where available the presence of an output from any SA/SD equipment present.
- 2.54 The following control facilities are also to be provided and may be used via an operator panel.
- vii) select mode of operation;
- viii) select and hold a vehicular stage;
- ix) insert a pedestrian demand, either singularly or continuously;
- x) select and hold the signals on the vehicular (all-red) clearance period;
- xi) select and hold the signals on the pedestrian (all-red) clearance period
- Note: Facilities ii) – v) above become operative when manual mode is selected.
- head basis and, if provided, shall comply with clause 2.59.
- 2.59 This dimming facility shall automatically reduce the intensity of the light signal when the ambient light level is low. The associated ambient light level(s) shall be as per TOPAS 2523.
- 2.60 The on-axis dimmed level of the signal shall be in the range of 15% to 38% of the on-axis bright level.
- 2.61 Aspects shall immediately switch to full intensity on failure of the dimming facility.

Speed Assessment/Speed Discrimination (Appendices A,C,D,E)

- 2.62 Equipment shall be capable of being used with Speed Assessment (SA) or Speed Discrimination (SD) equipment when used on High Speed Roads (defined as roads with an 85th percentile approach speed equal to or greater than 35mph)
- 2.63 The requirements for SA/SD equipment are defined in TOPAS 2500.
- 2.55 Signal Phases may be configured as Stages.
- 2.56 Where a configured stage is held under Manual Control, all phases in that stage shall be viewable by the operator on the Control panel.
- 2.57 Stages that combine Pedestrian and Traffic Phases shall not be allowed in portable applications.

Dimming

- 2.58 Provision may be made for the dimming of the signal aspects during periods of low ambient light conditions. Dimming may be provided for the whole signal installation, on an individual signal

Part Time Operation

- 2.64 The traffic signals may be switched on or off at specific times or for specific tasks or reasons. Switch-on of signals shall be as defined in the relevant start-up sequence. The signals shall be switched off under part-time control during a nominated stage provided that all minimum running periods have expired.

3. REFERENCES

3.1 Where undated references are listed, the latest issue of the publication applies.

Standards

3.2 British Standards are published by the British Standards Institution, London.

BS EN 50293	Electromagnetic Compatibility Road Traffic Signal Systems Product Standard
BS EN 12675	Traffic Signal Controllers - Functional Safety Requirements
BS EN 12368	Traffic Control Equipment - Signal heads
BS EN 50556	Road Traffic Signal Systems

Specifications

3.3 TOPAS Limited specifications are available at www.topasgroup.org.uk

TOPAS 0600	Self-Certification and Approval of Equipment for the Control of Vehicular and Pedestrian Traffic on Roads
TOPAS 2508	Performance Specification for Tactile Equipment for use at Pedestrian Crossings
TOPAS 2509	Performance Specification for Audible Equipment for use at Pedestrian Crossings
TOPAS 2130	Environmental Tests for Road Traffic Control Equipment
TOPAS 2504	Performance Specification for Vehicle Detection Equipment for Vehicle Actuated Portable Traffic Signals
TOPAS 2505	Performance Specification for Above Ground Vehicle Detector Systems for use at Permanent Traffic Signals Installations
TOPAS 2511	Performance Specification for Nearside Signal and Demand Units
TOPAS 2512	Performance Specification for Below Ground Vehicle Detection Equipment
TOPAS 2581	Performance Specification for Pedestrian Countdown Units for use at Traffic Signals
MCE 0108	Siting of inductive loops for vehicle detecting equipment at permanent road traffic signal installations

Other Publications

TSR&GD Traffic Signs Regulations and General Directions
Safety at Street Works and Road Works – A code of Practice (The Red Book)
Traffic Signs Manual

APPENDIX A

Performance Specification for Traffic Control Equipment for Use at Haul Route Crossings (formerly TR2501A)

FUNCTIONAL REQUIREMENTS

Modes of Operation

Light Signals

- A2.1 The purpose of the Product defined in this specification is to control haul route traffic crossing over a public highway between sites or within a single site.
- A2.2 The displayed signals shall comply with;
- Signal optical performance – TSRGD 2016 Schedule 14 Part (1) para 3.
 - Signal sequence - TSRGD 2016 Schedule 14 Part (1) para 4.
- A2.3 The light signals to be used with the Product shall comply with TSRGD 2016 Diagram 3000.
- A2.4 The dimension and finish of the signal posts shall comply with TSRGD 2016 Schedule 14 General Direction 5.

General

- A2.5 A minimum green vehicle signal period shall be associated with the start of every stage and no signal change shall be possible during this period.
- A2.6 The minimum green running period for each stage shall be configurable to either 7 or 12 seconds.
- A2.7 An all-red vehicle signal period of configurable duration between 1 to 50 seconds following each stage shall not be violated.

Vehicle Actuated (VA)

- A2.8 The Product shall employ a vehicle detection sub-system in accordance with;
- TOPAS 2505 Appendix A; or
 - TOPAS 2505 Appendix F (with 'nudge' feature disabled) for Haul Route approach only
- A2.9 On selection of VA mode, demands for all stages shall be registered in the equipment. The Product shall then respond to all further demands as specified.

- A2.10 The Product shall operate each stage in cyclic order in accordance with vehicle demands and extensions.
- A2.11 The Product shall detect the passage of vehicles during a green vehicle signal phase and extend the green period in proportion to the amount of traffic detected without unduly penalising the traffic on the opposing stage.
- A2.12 If a demand for an opposing stage is registered while a vehicle is still being detected on the running stage, then subject to the limitation of the maximum green running period, the running stage shall be extended beyond the minimum green running period for a further period of 2 seconds.
- A2.13 The maximum period that a vehicular green signal may be held by vehicular extensions after a demand has been registered for an opposing stage shall be preset at a value in the range between 10 and 60 secs and adjustable in incremental steps no greater than 5 seconds.
- A2.14 In the event of a green period being terminated by the operation of the maximum green running period, provision shall be made to ensure that a demand is registered for a return to the interrupted stage as soon as possible.
- A2.15 Right of way shall remain on the nominated phase after the expiry of the max green time in the absence of any demand on an opposing phase.
- A2.16 As a selectable option to A2.15, after the expiry of the max green time in the absence of any demand on opposing phase signals shall revert to all red.
- A2.17 On the failure of a vehicle detector a permanent demand shall be registered for the appropriate stage.

Manual Control (MC)

- A2.18 A suitably marked facility for selecting the individual modes of control shall be provided on the operator's panel. The control facilities shall include:
- i) select any stage in any sequence;
 - ii) select and hold the signals at all-red;
 - iii) when changing between stages or settings the signal sequencing and preset timings for red/amber and amber as defined in Table 2 shall be maintained.

Hold All-red Facility

- A2.19 A non-latching facility shall be provided for holding all the signal heads at the All-red condition when in VA mode.
- A2.20 This facility holds the system in All-red when the cycle sequence normally moves to an All-red state.
- A2.21 This facility shall be mounted on the outside of the controller housing. This shall be unmarked and easily accessible to the operator.

APPENDIX B

Performance Specification for Portable Traffic Signal Control Equipment for Use at Roadworks (formerly TOPAS 2502B)

FUNCTIONAL REQUIREMENTS

Light Signals

- B2.1 The light signals to be used are prescribed in TSRGD 2016 Diagram 3000.1
- B2.2 The displayed signals shall comply with;
- Signal optical performance – TSRGD 2016 Schedule 14 Part (1) para 3.
 - Signal sequence - TSRGD 2016 Schedule 14 Part (1) para 4.
- B2.3 The dimension and finish of the signal supports shall comply with TSRGD 2016 Schedule 14 General Direction 5.

Modes of Operation

General

- B2.4 The Product shall be capable of operating under:
- i) Vehicle Actuation (VA);
 - ii) Manual Control; and
 - iii) Fixed Time (FT)

- B2.5 A suitably marked facility for selecting the mode shall be provided.

(see Control Facilities and Indications)

- B2.6 A minimum green vehicle signal period shall be associated with the start of every stage and no signal change shall be possible during the minimum green period. The minimum green running period for each stage shall be configurable to either 7 or 12 seconds.

- B2.7 An all-red period to follow each stage shall be user configurable between 1 and 50 seconds by 1 second increments. Different all-red times may be set for different stages. On stage changes under all control modes the all-red time shall not be violated. Under manual control the operator may call and hold all-red as a stage.

Vehicle Actuated (VA)

- B2.8 The Product shall employ a vehicle detection sub-system registered to TOPAS 2505 Appendix F.
- B2.9 On selection of VA mode, demands for all stages shall be registered in the equipment. The Product shall then respond to all further demands as specified.
- B2.10 The Product shall operate each stage in cyclic order in

- accordance with vehicle demands and extensions.
- B2.11 The Product shall detect the passage of vehicles during a green signal period and extend this period in proportion to the amount of traffic detected without unduly penalising the traffic on opposing stages.
- B2.12 The maximum period that a vehicular green signal may be held by vehicular extensions after a demand has been registered for an opposing stage shall be preset at a value in the range between 10 and 60 secs and adjustable in incremental steps no greater than 5 seconds.
- B2.13 In the absence of demands on opposing stages, the green vehicle signal on the running stage shall be held by an extension beyond the minimum green period for a further 15 seconds.
- B2.14 If a demand is present on an opposing stage, during the green running time the extension time shall be reduced to 2 seconds.
- B2.15 If the opposing demand is registered during the 15 second extension in B2.13 when it has run for less than 2 seconds, the extension period shall be terminated after 2 seconds.
- B2.16 If further running stage demands are registered during the 2 second extension period, subsequent extensions shall be 2 seconds up to the limit of the maximum green period.
- B2.17 In the continued absence of opposing demands the maximum green period may be extended with subsequent extensions.
- B2.18 In the event of a green period being terminated by the operation of the maximum green running period, provision shall be made to ensure that a demand is registered for a return to the interrupted stage as soon as possible.
- B2.19 In the event of a green period being terminated by no extension signal on that stage, when there is no demand on an opposing stage, a return to the interrupted stage by an all-red period not less than 2 sec is permitted.
- B2.20 After the expiry of the max green time in the absence of any demand on an opposing phase signals shall revert to all red.
- B2.21 On the failure of a vehicle detector a permanent demand shall be registered for the appropriate stage.

Fixed Time (FT)

- B2.22 The Product shall continuously cycle through its stages sequentially with a fixed configurable maximum green period for each stage.

Manual Control (MC)

- B2.23 Manual selection of configured stages (including all-red) shall be possible.
- B2.24 It shall not be possible for the minimum green running period to be omitted or foreshortened by manual control.
- B2.25 When switching to Manual Control, from VA, or FT, any demand for a stage not running shall be cancelled.
- B2.26 If the change to Manual Control is made whilst the signals are in:
- i) amber or red/amber the

- ii) signals shall continue to cycle through on the fixed, or selected timings until vehicular green is reached;
- iii) all-red prior to a vehicular green selected the all-red shall continue, without interruption, as if it has been pre-selected;
- iv) all-red other than that prior to the green selected, an all-red period of at least that expected to follow the previous stage shall expire before the change.
- v) vehicular green selected, the signals, after satisfying the minimum green period, shall continue until a different command is selected on Manual, or the operation returned to VA, or FT.
- vi) on a different vehicular green to that selected, a change to the selected green shall take place following the expiry of the minimum green and the appropriate inter-green between the running green and that selected.

APPENDIX C

Performance Specification for Pedestrian Facilities at Temporary Standalone Traffic Signals (formerly TOPAS 2503B)

FUNCTIONAL REQUIREMENTS

TSRGD 2016 Schedule 14
General Direction 5.

Light Signals & Pedestrian Push Buttons

- C2.1 The displayed signals shall comply with;
- Signal optical performance – TSRGD 2016 Schedule 14 Part (1) para 3. (Both vehicular and pedestrian far side)
 - Signal sequence - TSRGD 2016 Schedule 14 Part (1) para 4.
- C2.2 The vehicular light signals shall comply with TSRGD 2016 Diagram 3000.
- C2.3 The pedestrian signal displays and push button or demand unit shall comply with either:
- TSRGD 2016 diagrams 4002.1 and 4003; or
 - Diagrams 4002.1 and 4003.8; or
 - Diagram 4003.1.
- C2.4 The dimension and finish of the signal posts shall comply with

Modes of Operation

General

- C2.5 Appropriate means shall be provided so that the pedestrian phase can be demanded using the push button box.
- C2.6 A registered demand shall be latched and shall be removed on commencement of the pedestrian green man signal.
- C2.7 The demand shall be confirmed by displaying the Wait signal on the pedestrian push button box.
- C2.8 When in the Vehicle Actuated mode the controller shall respond to signals generated by detectors installed to detect the presence of vehicles approaching or passing through the controlled area and pedestrian demands registered from the Push Button Box.
- C2.9 When in the Manual mode the controller shall respond only to the operation of manually operated commands from an

operator's panel via authorised personnel.

Vehicle Actuated Operation (VA)

- C2.10 The Product shall employ a vehicle detection sub-system approved to TOPAS 2505 Appendix A.
- C2.11 On selection of VA mode, demands for all vehicle and pedestrian stages shall be inserted and the controller shall then respond to this and all further demands.
- C2.12 The Product shall operate each stage in turn in accordance with vehicle demands and extensions and pedestrian demands.
- C2.13 The Product shall detect the passage of vehicles during a green signal period and extend this period in proportion to the amount of traffic detected.
- C2.14 The vehicle phase shall terminate, when a pedestrian demand is registered: and,
- i) the minimum green period, pre-set at 10 seconds, has expired and no vehicle extensions are present; or
 - ii) the maximum green running period has expired.
- C2.15 The Maximum Green running period shall be timed from the receipt of a pedestrian demand.
- C2.16 If a pedestrian demand is generated when the green pedestrian signal is not being displayed a demand shall be latched and shall be removed at the commencement of the pedestrian green period.
- C2.17 The "WAIT" indicators or push buttons indicators (as appropriate) on all pushbutton boxes related to a particular pedestrian phase shall be illuminated when there is a latched demand present for that phase.
- C2.18 If a pedestrian demand is registered while a vehicle is still being detected on the vehicle stage, then subject to the limitation of the maximum green running period, the running stage shall be extended beyond the minimum green running period for a further period of 2 seconds.
- C2.19 The maximum period that a green signal may be held by vehicle extensions after a demand for right of way has been registered on the pedestrian phase shall be preset at a value in the range between 10 to 60 seconds, and adjustable in incremental steps of not less than 5 seconds.
- C2.20 In the event of the vehicle green period being terminated by the operation of the maximum green running period, provision shall be made to ensure that a demand is registered for a return to the interrupted stage as soon as possible.
- C2.21 Right of way shall remain on the nominated phase after the expiry of the max green time in the absence of any demand on an opposing phase.
- C2.22 On the failure of a vehicle detector a permanent demand shall be registered for the appropriate stage.

Vehicle to Pedestrian Inter-green

- C2.23 This period shall immediately follow the vehicular stage and shall comprise:
- i) A fixed period of three seconds during which the signals shall display vehicular amber and pedestrian red;
 - ii) This shall be followed by a period of three seconds during which the signals shall display vehicular red and pedestrian red (the vehicular clearance period). This period can only be extended above three seconds by the intervention of manual control or SA/SD equipment (if used).

Invitation-to-Cross Period

- C2.24 This is the period during which the signals shall display vehicle red and pedestrian green shall immediately follow the vehicle to pedestrian phase and shall be preset at a value of 7 seconds. (Please also note F7, F8 & F9)

Pedestrian to Vehicle Inter-green

- C2.25 This inter-green period shall immediately follow the Invitation-to Cross period, and shall comprise the following:

	TSRGD 2016 diagrams 4002.1 and 4003; or Diagrams 4002.1 and 4003.8;	TSRGD 2016 Diagram 4003.1.
Blackout	Pre-set in the range 3-15 secs	n/a 0 secs
All red	Pre-set in the range 1-3 secs	Pre-set in the range 4-18 secs
Pedestrian Red & Vehicle Red/Amber	Fixed 2 secs	Fixed 2 secs

- C2.26 Pre-set timings to be settable in 1 second increments.

Manual Control (MC)

- C2.27 A suitably marked facility for selecting the individual modes of control shall be provided on the operator's panel. The control facilities shall include select and hold the vehicle phase;
- i) insert a pedestrian demand, either singularly or continuous;
 - ii) select and hold the signals at all-red. It shall not be possible to foreshorten the all-red period;

- iii) move to the all-red clearance period directly from either phase and initiate an immediate change to this period, subject only to the minimum green period, without the need to select the next right of way.
- C2.28 If the right of way is switched from one phase to the other, neither the amber signal, red/amber signal, or pre-set all-red shall be omitted or manually foreshortened.
- C2.29 It shall not be possible for either phase to be changed until the minimum green running period has expired.
- C2.30 When switching to Manual Control, from VA, any demand for the phase not running shall be cancelled.
- C2.31 If the change to Manual Control is made whilst the signals are:
- i) either vehicle or pedestrian green, then the green shall continue, without interruption, as if it has been pre-selected; all-red, then the all-red shall continue, without interruption, as if it has been pre-selected.

APPENDIX D

Performance Specification for Portable Traffic Control Equipment with Pedestrian Facilities for Use at Roadworks (formerly TOPAS 2537A)

FUNCTIONAL REQUIREMENTS

Capability

- D2.1 The Product shall be capable of controlling at least
1. two vehicle phases; and
 2. one pedestrian phase.

Light Signals & Pedestrian Push Buttons

- D2.2 The vehicular light signals shall comply with TSRGD 2016 Diagram 3000.1.
- D2.3 The displayed signals shall comply with;
- Signal optical performance – TSRGD 2016 Schedule 14 Part (1) para 3. (Both vehicular and pedestrian far side)
 - Signal sequence - TSRGD 2016 Schedule 14 Part (1) para 4.
- D2.4 The pedestrian signal displays and push button or demand unit shall comply with either:
- TSRGD 2016 diagrams 4002.1 and 4003; or
 - Diagrams 4002.1 and 4003.8; or
 - Diagram 4003.1.

- D2.5 The dimension and finish of the signal posts shall comply with TSRGD 2016 Schedule 14 General Direction 5.

Hazardous Signal Displays

The following table indicates those signal states of conflicting phases (vehicle/vehicle or vehicle/ pedestrian) which represent a hazardous signal display:

		Opposing phase display				
Phase display		Green	Amber	Red	Red Amber	Ped blackout
	Green	•	•		•	•
Amber	•	•		•	•	
Red						
Red Amber	•	•		•	•	

• Conflicting signal display

Fig 1: Conflicting vehicle displays:

Modes of Operation

General

- D2.6 The Product shall be capable of operating under:
- i) Vehicle Actuation (VA);
 - ii) Manual Control; and
 - iii) Fixed Time (FT)

- D2.7 A suitably marked facility for selecting the mode shall be provided.
(see Control Facilities and Indications)
- D2.8 A minimum green vehicle signal period shall be associated with the start of every stage and no signal change shall be possible during the minimum green period. The minimum green running period for each stage shall be configurable to either 7 or 12 seconds.
- D2.9 An all-red period to follow each vehicle stage shall be user configurable between 1 and 50 seconds by 5 second increments. Different all-red times may be set for different stages. On stage changes from a wholly vehicular stage to another wholly vehicular stage under all control modes the all-red time shall not be violated. Under manual control the operator may call and hold all-red as a stage.
- Vehicle Actuated (VA)**
- D2.10 The Product shall employ a vehicle detection sub-system approved to TOPAS 2505 Appendix F.
- D2.11 On selection of VA mode, demands for all vehicle and pedestrian stages shall be inserted and the controller shall then respond to this and all further demands.
- D2.12 The Product shall operate each stage in cyclic order in accordance with vehicle demands and extensions and pedestrian demands.
- D2.13 The Product shall detect the passage of vehicles during a green signal period and extend this period in proportion to the amount of traffic detected without unduly penalising the traffic on opposing stages.
- D2.14 The maximum period that a vehicular green signal may be held by vehicular extensions after a demand has been registered for an opposing stage (vehicular or pedestrian) shall be preset at a value in the range between 10 and 60 seconds, and adjustable in incremental steps no greater than 5 seconds.
- D2.15 In the absence of demands on opposing stages, the green vehicle signal on the running stage shall be held by an extension beyond the minimum green period for a further 15 seconds.
- D2.16 If a demand is present on an opposing stage, during the green running time the extension time shall be reduced to 2 seconds.
- D2.17 If the opposing demand is registered during the 15 second extension in D2.15 when it has run for less than 2 seconds, the extension period shall be terminated after 2 seconds.
- D2.18 If further running stage demands are registered during the 2 second extension period, subsequent extensions shall be 2 seconds up to the limit of the maximum green period.
- D2.19 In the continued absence of opposing demands the maximum green period may be extended with subsequent extensions.
- D2.20 In the event of a green period being terminated by the operation of the maximum green running period, provision shall be made to ensure that a demand is registered for a return to the interrupted stage as soon as possible.
- D2.21 In the event of a green period being terminated by no extension signal on that stage, when there is

no demand on an opposing stage, a return to the interrupted stage by an all-red period not less than 2 sec is permitted.

D2.22 Where the next stage is a pedestrian stage, the preceding vehicle stage shall terminate, when a pedestrian demand is registered: and,

- i) the minimum green period has expired and no vehicle extensions are present; or
- ii) the maximum vehicular green running period has expired.

D2.23 If a pedestrian pushbutton is pressed when the green pedestrian signal is not being displayed a demand shall be latched and shall be removed at the commencement of the pedestrian green period.

D2.24 The "WAIT" indicators or push button indicators (as appropriate) on all push button boxes related to a particular pedestrian phase shall be illuminated when there is a latched demand present for that phase.

D2.25 After the expiry of the max green time in the absence of any demand on an opposing phase, signals shall revert to all red.

D2.26 On the failure of a vehicle detector a permanent demand shall be registered for the appropriate stage.

Vehicle to Pedestrian Inter-green

D2.27 This period shall immediately follow the appropriate vehicular stage and shall comprise

- i) A fixed period of three seconds during which the signals shall display vehicular amber and pedestrian red.
- ii) This shall be followed by the full all-red vehicular clearance period which shall not be less than three seconds. During this period the signals shall display vehicular red and pedestrian red (the vehicular clearance period). This period can only be extended by the intervention of manual control or SA/SD equipment if used.

Invitation-to-Cross Period

D2.28 During this period the signals shall display vehicular red and pedestrian green. It shall immediately follow the vehicular to pedestrian inter-green and shall be fixed at 7 seconds. (Please also note F7, F8 & F9)

Pedestrian to Vehicular Inter-green

D2.29 This shall immediately follow the Invitation-to-cross period, and shall comprise the following:

	<i>TSRGD 2016 diagrams 4002.1 and 4003; or</i>	<i>TSRGD 2016 Diagram 4003.1.</i>
	<i>Diagrams 4002.1 and 4003.8;</i>	
Blackout	Pre-set in the range 3-15 secs	n/a 0 secs
All red	Pre-set in the range	Pre-set in the range

	1-3 secs	4-18 secs
Pedestrian Red & Vehicle Red/Amber	Fixed 2 secs	Fixed 2 secs

D2.30 Pre-set timings to be settable in 1 second increments.

Fixed Time (FT)

D2.31 The Product shall continuously cycle through its stages sequentially with a fixed configurable maximum green period for each stage.

D2.32 Each pedestrian "WAIT" indicator or push button indicator (as appropriate) shall be illuminated at all times when its associated pedestrian signal shows red.

Manual Control (MC)

D2.33 Manual selection of configured stages (including all-red) shall be possible.

D2.34 It shall not be possible for the minimum green running period to be omitted or foreshortened. The amber, red/amber and pedestrian black-out shall not be selectable under Manual Control.

D2.35 When switching to Manual Control, from VA, or FT, any demand for a stage not running shall be cancelled.

D2.36 If the change to Manual Control is made whilst the signals are in:

- i) amber or red/amber the signals shall continue to cycle through on the fixed, or selected timings until vehicular green is reached;

- ii) all-red prior to a vehicular green selected the all-red shall continue, without interruption, as if it has been pre-selected;
- iii) all-red other than that prior to the green selected, an all-red period of at least that expected to follow the previous stage shall expire before the change.
- iv) vehicular green selected, the signals, after satisfying the minimum green period, shall continue until a different command is selected on Manual, or the operation returned to VA, or FT.
- v) on a different vehicular green to that selected, a change to the selected green shall take place following the expiry of the minimum green and the appropriate inter-green between the running green and that selected.

APPENDIX E

Performance Specification for Portable Traffic Signal Control Equipment for Standalone Pedestrian Facility (formerly TOPAS 2538A)

- Diagram 4003.1.

FUNCTIONAL REQUIREMENTS

Capability

- E2.1 The Product shall be capable of operating a two stage pedestrian facility (one vehicle stage and one pedestrian stage). The Product shall be capable of operating at least two pedestrian aspects and four vehicular aspects per stage.

- E2.5 The dimension and finish of the signal supports shall comply with TSRGD 2016. Schedule 12 General Direction 5

Light Signals & Pedestrian Push Buttons

- E2.2 The vehicle light signals shall comply with TSRGD 2016 Diagram 3000.1.
- E2.3 The displayed signals shall comply with;
- Signal optical performance – TSRGD 2016 Schedule 14 Part (1) para 3. (Both vehicular and pedestrian far side)
 - Signal sequence - TSRGD 2016 Schedule 14 Part (1) para 4.
- E2.4 The pedestrian signal displays and push button or demand unit shall comply with either:
- TSRGD 2016 diagrams 4002.1 and 4003; or
 - Diagrams 4002.1 and 4003.8; or

Hazardous Signal Displays

Figure 1 indicates those signal states of conflicting phases (vehicle/vehicle or vehicle/pedestrian) which represent a hazardous signal display.

	Vehicular display			
Pedestrian display	Green	Amber	Red	Red
				Amber
Green	•	•		•
Red				
Ped black out	•	•		•

- Conflicting signal display

Fig 1: Conflicting signal displays

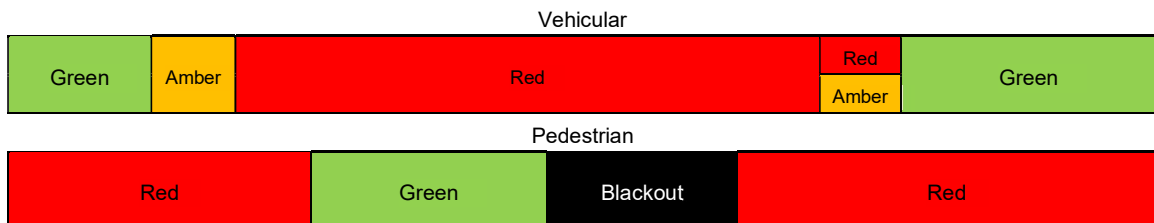


Fig 2: Permitted pedestrian and vehicle signal sequences.
(Non-permitted sequences represent hazardous displays)

Modes of Operation

General

- E2.6 The Product shall be capable of operating under:
- i) Vehicle Actuation (VA);
 - ii) Manual Control; and
 - iii) Fixed Time (FT)
- E2.7 A suitably marked facility for selecting the mode shall be provided (see Control Facilities and Indications).
- E2.8 A minimum green vehicle signal period shall be associated with the start of every stage and no signal change shall be possible during the minimum green period. The minimum green running period for each stage shall be configurable to either 7 or 12 seconds.

Vehicle Actuated (VA)

- E2.9 The Product shall employ a vehicle detection sub-system approved to TOPAS 2505 Appendix F.
- E2.10 On selection of VA mode, demands for all vehicle and pedestrian stages shall be inserted and the controller shall then respond to this and all further demands.
- E2.11 The Product shall operate each stage in turn in accordance with vehicle demands and extensions and pedestrian demands.
- E2.12 The Product shall detect the passage of vehicles during a green signal period and extend

this period in proportion to the amount of traffic detected.

- E2.13 The vehicle phase shall terminate, when a pedestrian demand is registered: and,
- i) the minimum green period, pre-set at 10 seconds, has expired and no vehicle extensions are present; or
 - ii) the maximum green running period has expired.
- E2.14 The Maximum Green running period shall be timed from the receipt of a pedestrian demand
- E2.15 If a pedestrian demand generated when the green pedestrian signal is not being displayed a demand shall be latched and shall be removed at the commencement of the pedestrian green period.
- E2.16 The "WAIT" indicators or push buttons indicators (as appropriate) on all pushbutton boxes related to a particular pedestrian phase shall be illuminated when there is a latched demand present for that phase.
- E2.17 If a pedestrian demand is registered while a vehicle is still being detected on the vehicle stage, then subject to the limitation of the maximum green running period, the running stage shall be extended beyond the minimum green running period for a further period of 2 seconds.
- E2.18 The maximum period that a vehicular green signal may be held by vehicular extensions after a demand has been

registered for the pedestrian stage shall be preset at a value in the range between 10 and 60 seconds, and adjustable in incremental steps no greater than 5 seconds.

- E2.19 In the event of the vehicle green period being terminated by the operation of the maximum green running period, provision shall be made to ensure that a demand is registered for a return to the interrupted stage as soon as possible.
- E2.20 Right of way shall remain on the nominated phase after the expiry of the max green time in the absence of any demand on an opposing phase.
- E2.21 On the failure of a vehicle detector a permanent demand shall be registered for the appropriate stage.

Vehicular to Pedestrian Inter-green

- E2.22 This period shall immediately follow the vehicular stage and shall comprise:
 - iii) A fixed period of three seconds during which the signals shall display vehicular amber and pedestrian red;
 - iv) This shall be followed by a period of three seconds during which the signals shall display vehicular red and pedestrian red (the vehicular clearance period). This period can only be extended above three seconds by the intervention

of manual control or SA/SD equipment (if used).

Invitation-to-Cross Period

- E2.23 During this period the signals shall display vehicular red and pedestrian green. It shall immediately follow the vehicular to pedestrian inter-green and shall be fixed at 7 seconds. (please also note F7, F8 & F9)

Pedestrian to Vehicular Inter-green

- E2.24 This shall immediately follow the Invitation-to-cross period, and shall comprise the following:

	<i>TSRGD 2016 diagrams 4002.1 and 4003; or</i>	<i>TSRGD 2016 Diagram 4003.1.</i>
	<i>Diagrams 4002.1 and 4003.8;</i>	
Blackout	Pre-set in the range 3-15 secs	n/a 0 secs
All red	Pre-set in the range 1-3 secs	Pre-set in the range 4-18 secs
Pedestrian Red & Vehicle Red/Amber	Fixed 2 secs	Fixed 2 secs

- E2.25 Pre-set timings to be settable in 1 second increments.

Fixed Time (FT)

- E2.26 The Product shall continuously cycle between the vehicle stage and the pedestrian stage using the pedestrian invitation period and maximum green timings set for VA working.
- E2.27 Each pedestrian "WAIT" indicator or push button indicator (as appropriate) shall be illuminated at all times when its associated pedestrian signal shows red.

Manual Control (MC)

- E2.28 When switching to:
- i) the vehicular green; or
 - ii) the pedestrian green
- it shall not be possible for the following periods to be omitted or manually foreshortened: the amber, red/amber, clearance period/ periods, pedestrian green, pedestrian black-out periods.
- E2.29 The amber, red/amber, pedestrian black-out shall not be selectable under Manual Control.
- E2.30 It shall not be possible for the minimum green running period to be omitted or foreshortened by manual control.
- E2.31 When switching to Manual Control, from VA, any demand for the phase not running shall be cancelled.
- E2.32 If the change to Manual Control is made whilst the signals are in the amber, red/amber, pedestrian green, pedestrian

blackout, or either clearance period, the signals shall continue to cycle through on the fixed, or selected timings until vehicular green is reached.

- E2.33 If the change to Manual Control is made whilst the signals are in the vehicular green period, the signals, after satisfying the minimum green period, shall continue until a different command is selected on Manual, or the operation returned to VA or FT.

APPENDIX F - INFORMATIVE GUIDE

General

- F1. This Appendix provides additional information regarding the use of portable and temporary traffic signals. It includes additional criteria which should be addressed by traffic authorities and other users in their procurement contracts.

Operating Range & All-Red Times

- F2. The minimum operating range of the products (specifically for Appendix B where shuttle-working facilities can be quite long) shall be 300m. You should note that the Traffic Authority may require special conditions to operate at this range. Some authorities require special permission at 250m.
- F3. In the guidance, a minimum of 1 sec of all red time is applied for 10m. For 300m a minimum of 30secs all red should be selected.
- F4. The all-red time allowed on the product is selectable up to 50 secs.

Pedestrian to Vehicle Intergreen

- F5. Chapter 6 provides for (non-extendable) far side signal blackout in the range 3-15secs and all red of 1-3 secs.
- F6. Some traffic authorities for F5 specify all red times which can be pre-set up to 10secs.

Invitation-to-Cross Period (Green Man)

- F7. This specification specifies a fixed invitation-to-cross-period of 7 secs.
- F8. Chapter 6 provides for an invitation-to-cross period in the range 4-12 seconds.
- F9. Some traffic authorities call for periods other than 7 secs.

Stages and Phases

- F10. Portable signals as defined in 1.10 & 1.11 are smaller & easily movable by design and are not safe to support any stage that contains both vehicular and pedestrian phases.
- F11. Portable signals are principally phase based signals but a facility to link vehicular phases may be provided.

F12. Timing Tolerance and Range Sizes

Parameter	Value/Range	Maximum Step Size	Applicable Appendices	Tolerance	Fixed/Alterable
Mandatory Signal Timings (as defined in TSRGD)					
Red/Amber	2 sec	-	A,B,C,D,E	A	Fixed
Amber	3 sec	-		A	Fixed
Signal Timings – Working Values					
Phase Min Green	7 or 12 secs	-	A,B,D	A	Fixed (option)
Phase Min Green	10 secs		C,E	A	Fixed
Vehicle Extension	2 secs	-	A,B,C,D,E	A	Fixed
Phase Green Maximum	10 – 60 secs	5 secs	A,B,C,D,E	A	Alt
All-Red	1 – 50 secs	1 sec	A,B,C,D,E	A	Alt
All-Red (Vehicle to ped intergreen)	3 secs	-	C,E	A	Fixed
Pedestrian Invitation-to-cross (Green Man)	7 secs	-	C,D,E	A	Fixed
Pedestrian Blackout (preset for far-side signals)	3-15 secs	1 sec	C,D,E	A	Alt
All-Red (far side signals) (Ped to vehicle intergreen)	1-3 secs	1 sec	C,D,E	A	Alt
Detector Fault Monitoring (Optional)					
Permanent Detect State timeout	0-60 min	1 min	A,B,C,D,E	C	Alt
Permanent non-detect state timeout	0-72 hrs	1hr	A,B,C,D,E	E	Alt

Timing Parameters

Tolerance; A ± 250ms, B ± 1sec, C ± 1 min, E ± 10min

F13. Summary of VA Operation

	APPENDICES	A	B	C	D	E
1	The Product shall employ a vehicle detection sub-system registered to TOPAS 2505 Appendix A.	A2.8		C2.10		
2	The Product shall employ a vehicle detection sub-system registered to TOPAS 2505 Appendix F.	opt	B2.8		D2.10	E2.9
3	On selection of VA mode, demands for all stages shall be registered in the equipment. The Product shall then respond to all further demands as specified.	A2.9	B2.9	C2.11	D2.11	E2.10
4	The Product shall operate each stage in fixed cyclic order in accordance with vehicle demands and extensions and pedestrian demands.	A2.10	B2.10	C2.12	D2.12	E2.11
5	The Product shall detect the passage of vehicles during a green signal period and extend this period in proportion to the amount of traffic detected without unduly penalising the traffic on opposing stages.	A2.11	B2.11	C2.13	D2.13	E2.12
6	The maximum green period will start after a demand has been registered for an opposing stage.	A2.13	B2.12	C2.15	D2.14	E2.14
7	The maximum green period shall be pre-set at a value in the range between 10 and 60 secs and adjustable in incremental steps no greater than 5 seconds.	A2.13	B2.12	C2.19	D2.14	E2.18
8	In the absence of demands on opposing stages, the green vehicle signal on the running stage shall be held by an extension beyond the minimum green period for a further 15 seconds.		B2.13		D2.15	
9	If a demand is present on an opposing stage, during the green running time the extension time shall be 2 seconds.	See 20	B2.14	C2.18	D2.16	E2.17
10	If the opposing demand is registered during the 15 second extension in clause 8 when it has run for less than 2 seconds, the extension period shall be terminated after 2 seconds.		B2.15		D2.17	
11	If further running stage demands are registered during the 2 second extension period, subsequent extensions shall be 2 seconds up to the limit of the maximum green period.	A2.12	B2.16	C2.18	D2.18	E2.17
12	In the continued absence of opposing demands the green period shall be extended with subsequent extensions.		B2.17		D2.19	
13	In the event of a green period being terminated by the operation of the maximum green running period, provision shall be made to ensure that a demand is registered for a return to the interrupted stage as soon as possible.	A2.14	B2.18	C2.20	D2.20	E2.19
14	In the event of a green period being terminated by no extension signal on that stage, when there is no demand on an opposing stage, a return to the interrupted stage by an all-red period not less than 2 sec is permitted.		B2.19		D2.21	
15	After the expiry of any extensions and in the absence of any demand on an <u>opposing phases</u> , the signals shall revert to all red.		B2.20		D2.25	
16	On the failure of a vehicle detector, a permanent demand shall be registered for the appropriate stage.	A2.17	B2.21	C2.22	D2.26	E2.21
17	Right of way shall remain on the nominated phase after the expiry of the max green time in the absence of any demand on an opposing phase.	A2.15	opt	C2.21	opt	E2.20
18	After the expiry of the maximum green time, in the absence of any demand on an opposing phase, signals shall revert to the nominated phase.	•	opt	•	opt	•
19	On implementation of option specified in 15, then detection sub-system shall employ 'nudge' function.		•		•	
20	If a demand is present on an opposing stage, during the green running time the extension time shall be pre-selected in the range 0.5 to 2.0 seconds in increments of 0.5secs.	A2.12	opt	opt	opt	opt
21	<u>Alternatively</u> to 6, the maximum green period will start at the beginning of the green signal period.	•				
22	The vehicle phase shall terminate, when a pedestrian demand is registered: <u>and</u>			•	•	•
	i) the minimum green period has expired and no vehicle extensions are present; or			C2.14(i)	D2.22(i)	E2.13(i)
	ii) the maximum green running period has expired.			C2.14(ii)	D2.22(ii)	E2.13(ii)
23	The "WAIT" indicators or push buttons indicators (as appropriate) on all pushbutton boxes related to a particular pedestrian phase shall be illuminated when there is a latched demand present for that phase.			C2.17	D2.24	E2.16
24	Pedestrian demands will not be registered when the <u>Green</u> man is illuminated.			C2.16	D2.23	E2.15

APPENDIX Z - TECHNICAL FILE CONTENT

This appendix defines the necessary content for a Technical File Pack (a collection of relevant documents) which must be reviewed by an appropriate Technical Assessor as part of the TOPAS Registration process (See TOPAS 0600).

Only the 'ticked' items are required to be present in a Technical File Pack used to support TOPAS Registration against TOPAS 2540.

Ref	Item	Description	Required
1	Technical File overview document	A summary document outlining the product, specifying which TOPAS and other relevant specification(s) the product has been designed to comply with, together with a detailed table of contents for the Technical File Pack. Where copies of external certificates or documents are referred to these may be included within the Technical File overview document or supplied separately as part of the Technical File Pack.	✓
2	QA accreditation certificate(s)	A copy of the Quality Management Registration Certificates for the organisation applying for TOPAS Product Registration.	✓
3	Details of all UKCA/CE markings that apply to the product	A list of all directives complied with and how achieved. Typically, this would be referenced to explicit CE/CA Technical Files and certificates, copies of which would be included in the Technical File Pack.	✓
4	A functional design description of the product	A reference to the overall System Design Documentation for the product (by document part number and issue).	✓
5	Product part numbers	A list of top level assembly part numbers and their issue states including all firmware / software part numbers and issues.	✓
6	Test procedures and results	A reference to all test schedules and test result documents (by document part number and issue).	✓
7	Statement of compliance	A clause by clause statement of compliance against TOPAS 2540 confirming compliance and/or listing caveats or deviations.	✓

8	EMC test results	A reference to EMC test performance requirements. Copies of the results of EMC testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	✓
9	Optical test results	A reference to Optical tests performance requirements. Copies of the results of Optical testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	✓
10	Environmental test results	A reference to Environmental tests performance requirements. Copies of the results of the Environmental testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack.	✓
11	Radio Test results (OFCOM IR 2030)	Copies of the results of Radio testing undertaken by an appropriately qualified independent approved test house must be included in the Technical File Pack. Reports should be those listed on the Declaration of Conformity & the Technical File or specific IR 2030 requirement. (Note this should be a report for the system radio device if the system comms is wireless and additionally a report for the radar device if the VA function is provided by a radar unless the radar is separately registered to TOPAS 2505).	✓✓
12	Primary Safety Test results	For Traffic Control equipment specifically a reference to the Primary Safety Test schedule and test results by part number and issue. A copy of the test results should be included as part of the Technical File Pack.	✓
13	Failure Mode Analysis	A reference to the product failure mode analysis requirements and results by document part number and issue.	✓