WAKA KOTAHI
NZ TRANSPORT AGENCY

ELECTRONIC MESSAGE SIGNAGE FONTS

ITS Core Requirements Standard

23 MARCH 2022
VERSION 0.8

New Zealand Government

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More information
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More information about intelligent transport systems (ITS) is available on the Waka Kotahi website at https://www.nzta.govt.nz/its

This document is available on the Waka Kotahi website at https://www.nzta.govt.nz/itsspecs

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1 DOCUMENT CONTROL

1.1 Document information

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1.2 Document owner

Role Head of Technology Engineering

Organisation Waka Kotahi

1.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
DD/MM/YYYY			

1.4 Version history – major changes

Document version control is the process of tracking and managing different versions (or drafts) of a document to easily identify the current iteration of a file.

This table shows a record of all major (published) versions of this document **(for Waka Kotahi use only)**. To record minor versions (author updates, amendments etc), go to section **Error! Reference source not found.** F ull version history.

Version	Date	Author	Role and organisation	Reason
1.0	DD/MM/YYYY			
2.0	DD/MM/YYYY			
3.0	DD/MM/YYYY			

2 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of Waka Kotahi.
PENDING	The document has been finalised and is pending approval and ratification by Waka Kotahi. It can be used for procurement at this status.
RATIFIED	The document is an official Waka Kotahi document. Road controlling authorities are obliged to follow a document with this status.
RETIRED	The document is obsolete, and/or superseded.
AADT	Annual average daily traffic
ATMS	Advanced Traffic Management System
Character height	Height of an upper-case character expressed in millimetres.
Character spacing	Horizontal spacing between individual characters on the same line of a message. It is made up of the two spaces (margins) to the right of the first character and to the left of the next character.
Display matrix	Visible part of an electronic sign or signal which contains the pixels that can be activated to display the message.
DMRB	Design Manual for Roads and Bridges
EJT	Estimated journey time
Expressway	High-speed roads, which may include well-spaced at-grade intersections – which means they often have accesses and driveways onto them and sometimes traffic signals or roundabouts.
HVU	High-volume urban
ITS	Intelligent transport systems
LCS	Lane and carriageway signals
LED	Light-emitting diode
Line spacing	Vertical space between lines of text, calculated as a percentage (between 0.4 and 0.6) of the uppercase font height and rounded to nearest number of pixels.
Margin	Space of blank pixels to the left or right of a character.
Message	Configuration consisting of symbols and/or text.
Motorway	Access controlled, high-speed roads that normally have grade-separated intersections – which means they have overbridges (or underpasses) so road users do not have stop at traffic lights.
Non-standard	Any font that does not have font maps included in this standard
Pixel	Smallest controllable element of a display matrix for an electronic sign or signal.
Pixel pitch	Distance between centres of adjacent pixels.
RCA	Road controlling authority

Term	Definition
Standard font	The font, which has font maps included in this standard
Stroke	Width of a line or curve that forms a character.
TOC	Transport operations centre
VMS	Variable message sign - an electronic sign where the information shown can be changed or switched on or off as required. The information can be text or symbols

3 OVERVIEW AND OUTCOMES

This section defines the core requirements to support operational outcomes for intelligent transport systems with respect to the transport network.

3.1 Purpose

Core standards outline common conditions and obligations and are applicable across all Waka Kotahi ITS design standards. Core specifications define common requirements and are applicable across all Waka Kotahi ITS delivery specifications. Their purpose is to provide clarity for each core subject area by managing duplication of common requirements within the design standards and delivery specifications.

The purpose of this standard is to provide requirements for fonts used on electronic signage. The target application of this document is SM031 and SM032 – State highway construction and maintenance contract proforma manuals.

3.2 Overview

A core standard is a set of global requirements for all ITS design standards, which are universally applicable unless otherwise stated.

Legacy low resolution VMS constrained the ability to define fonts in isolation of the display matrix, and the ability to support multiple font sizes.

As VMS, LCS signals and other electronic signage have coarse pixel spacing or predefined messages, this only allowed for a single set of fonts to be defined which were based on a 5x7 character block size or were fixed in place at the time of manufacture.

With the move to a higher resolution signage (signage with a smaller distance between pixels or smaller pixel pitch), the fonts are no longer constrained by the display matrix. This means that the older fonts based on legacy technologies are no longer suitable and a new font and visibility standard is required. This core requirements standard is suitable for application on all electronic signage (including some legacy devices) to define font dimensions.

3.2.1 Definition

Fonts define the way text-based information is presented to the reader, in this case how text is displayed on an electronic display matrix, ensuring the message is easy for road users to interpret.

While the majority of VMSs use a font file, which can be uploaded into the VMS, so the device can use the font information to format the characters that make up messages, some VMSs have an application which generates and manages the fonts based on a set of parameters and algorithms.

3.2.2 Waka Kotahi ITS class

001 Signs. Electronic displays which provide visual messages to transport network users.
Class definitions

3.3 Scope

This core requirements standard covers font standards and dimensions for electronic signage (including uppercase letters, digits and special characters).

Fonts defined in this core requirements standard cover all types of VMS and LCS as specified in the latest versions of ITS delivery specification: Variable message signs – fixed and ITS delivery specification: Lane and carriageway signals respectively. The document also contains business rules used to generate both standard (200mm, 300mm and 400mm) or any non-standard fonts that may be required for specialist applications.

Legacy VMS are not covered by this core requirements standard.

3.4 Outcomes

Electronic signs are one of the primary method used by Waka Kotahi to communicate to road users once they are travelling on the transport network. The key outcomes of this core requirements standard are to:

i. ensure that visibility requirements for operating environment are defined to ensure legibility of messages
ii. define a set of standard fonts that can be applied to VMS and LCS specified in the latest versions of ITS delivery specification: Variable message signs – fixed and ITS delivery specification: Lane and carriageway signals respectively, without being constrained by the device or technology
iii. define the set of business rules that can be applied to all electronic message signs used by road controlling authorities (RCAs) that are subject to the Land Transport Rule: Traffic Control Devices 2004 (TCD Rule). This does not include advertising signs.

3.4.1 Operational

The operational outcome of this core requirements standard is to:

i. support advanced messaging capabilities, such as:
   - uppercase fonts
   - special characters
   - digits.
ii. ensure RCAs and transport operations centres (TOCs) operational requirements are met
iii. ensure any current, and future, operational requirements are met (eg dual language support).

3.4.2 For users of the transport network

This core requirements standard ensures that transport network users can easily read and comprehend messages on the operational signage, and to maintain consistency and legibility across all electronic signs used by RCAs that are subject to the TCD Rule. This does not include advertising signs.

3.4.3 For road controlling authorities and transport operations centres

This core requirements standard enables RCAs and transport operations centres (TOCs) to:

i. support advanced messaging capabilities for the RCAs and TOCs
ii. achieve a consistent approach to font use on electronic signage

iii. achieve a consistent legibility of messages on electronic signage across New Zealand follow best working practice, and a pathway to compliance with TCD rule.

4 DESIGN FOR OPERATION

This section defines the core functionality required to support successful operation of the intelligent transport system.

4.1 Operational environment

The choice of electronic sign display is dictated by the location, intended operational application and message requirements.

The font is a function of VMS type selected according to the ITS design standard: Variable message signs – fixed, there is a close relationship between site selection and selection of the sign size/display technology..

Once these operational criteria are set, the requirements in this core requirements standard shall be applied.

4.2 Character height

Error! Reference source not found. below summarises the recommended minimum character height for m otorway, expressway, high-volume urban (HVU) and rural environments for a range of speed environments, and single or dual-lane roadways. VMS and LCS listed in the table shall comply with latest versions of ITS delivery specification: Variable message signs – fixed and ITS delivery specification: Lane and carriageway signals respectively.
The minimum character heights are based on:

i. the information from tables 1 and 2 of UK Design Manual for Roads and Bridges 2002 (DMRB) – The Use of Variable Message Signs on All-Purpose and Motorway Trunk Roads (Volume 8, Section 2, Part 2 TD 33/05 Traffic Signs and Lighting – Signs and Road Markings – VMS – NI)

	HVU and rural – side mount with <6m offset (from left hand side in the direction of travel)				**Motorway or expressway – overhead or side mount with <6m offset (from left hand side in the direction of travel)**		
	Single lane in the direction of travel	**Double lane in the direction of travel**	**Double lane in the direction of travel**				
Speed environment	**Four-line regional type A or C VMS**	**Four-line regional type A or C VMS**	**Three-line urban type D VMS**	**LCS**	**Three-line motorway VMS**	**Four-line regional type A VMS**	**LCS**
Up to 50km/h	200 (type C)	200 (type C)	200	200	–	–	–
51–70km/h	200 (type C)	300	200	300	–	–	–
71–100km/h	300	300	–	300	400	300	400

Table 1. Electronic signage – minimum character height

It should be noted that safety critical messages have a higher font. For example, if critical height detectors, which are part of an over-height detection system, are triggered, then the VMS shall be able to display a larger font, ie 500mm or greater.

4.3 Display attributes

4.3.1 Display size

The choice of electronic sign display is dictated by the operational environment and conditions, and message requirements. Detailed information on VMS types and display sizes are described in section 4 character heigh of the latest version of ITS design standard: Variable message signs – fixed, then in table 5 Waka Kotahi VMS types in section 7 (appendix A) of the latest version of ITS delivery specification: Variable message signs – fixed and **Error! Reference source not found.** in section 4.2 Character height of this core requirements s tandard.

Both vertical and horizontal spacing of pixels must be consistent across the entire display.

Full matrix signs are standard for all Waka Kotahi applications where flexibility to support text heights greater than the standard line height and/or graphics in the future is required.

4.3.2 Font colour options

The permitted colours for the font on electronic signage are yellow or white as per TCD rule.

Combination of colours are not allowed on the same display.

4.3.3 Font display business rules

Character, word and line spacing requirements provide a proportionally correct text appearance that allows the sign to be more easily read from a distance. Along with other parameters such as font height, they help the designer to determine sign size and therefore the requirements for space at the roadside/on a gantry for the sign. This is important for consistency across the range of electronic signs used on the New Zealand road network.

The business rules for developing an electronic font are as follows:

i. Character shape:
   - The shapes of fonts displayed on electronic signage shall be as near as practicable to Series D of AS 1744 (with the exception of the narrow font for urban type D VMS).
   - The character stroke width will be as per width of the letter I for the corresponding font height, as shown on Figure 2.
   - For characters with a single vertical stroke, ie I, J and T, only T must have a horizontal stroke at the top to avoid confusion between these characters.
   - Characters that have a diagonal stroke, ie A, X, Y, and V, must use the diagonal stroke format rather than a vertical stroke to establish the character shape.

Incorrect character format **Correct character format**

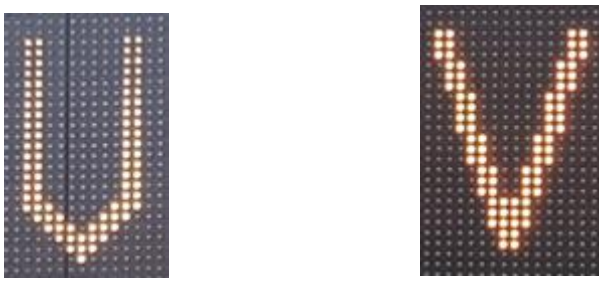


Figure 1. Comparison of permitted and non-permitted characters

ii. Character, word and line spacing:

- A character slot is made up of the two spaces (margins): to the right of the first character and to the left of the next character. A margin is the number of unilluminated pixel columns to the left or to the right of a character. The left and right margins are specific to each character. Standard fonts (200mm, 300mm and 400mm) shall comply with font maps explaining the character dimensions and margin spacing as defined in Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts of this core requirements standard. Character dimensions and spacing for special non-standard fonts shall be developed using information from the table titled Standard Alphabets Spacing Chart in Series D of AS 1744:2015 Standard alphabet for road signs (Series D of AS 1744). NOTE: character slots for Q and comma "," are 1 pixel higher and they both have an extra pixel below the baseline of all other characters.
- When a character message is composed a character slot representing a character and both margins is set next to the following character slot. See relevant sections of Appendix A: in this core requirements standard. For horizontal spacing between words, a blank character for a corresponding font shall be used. The blank character has associated zero-margin spacing.
- Line spacing, as further defined in Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts in this core requirements standard.
- Lines of text shall be middle aligned horizontally and vertically

4.3.4 VMS and LCS controller requirements for font display

VMS and LCS controllers (as applicable) shall be capable of generating the display fonts and text layout as detailed in table 2 below.

Attribute	VMS parameter	LCS parameter
Font	As near as practicable to uppercase font as defined in Series D of AS 1744. Font maps of standard fonts (200mm, 300mm and 400mm) are shown in Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts	NOTE: It is only applicable to digits. As near as practicable as defined in Series D of AS 1744. Font maps of standard fonts (200mm, 300mm and 400mm) are shown in Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts
Character height	See **Error! Reference source not f ound.**, in this core requirements standard.	NOTE: It is only applicable to digits.

Attribute	VMS parameter	LCS parameter
	Application depends on operational environment.	See **Error! Reference source not found.**, in this core requirements standard. Application depends on operational environment.
Character width	See Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts.	NOTE: It is only applicable to digits. See Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts.
Character spacing – horizontal	See Appendix A: . Must be equal to or exceed a stroke width.	NOTE: It is only applicable to digits. See Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts.
Word spacing – horizontal	One blank character– consistent for the same electronic sign (this is a dimensionless number derived from the font height). For the dimensions of blanks character in case of standard font see Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts. In case of non-standard font see the table titled Standard Alphabets Spacing Chart in Series D of AS 1744:2015 Standard alphabet for road signs (Series D of AS 1744)	Not applicable.
Line spacing	For the standard font, see corresponding information in Appendix A: Waka Kotahi font maps for standard VMS and LCS fonts For non-standard font it shall be between 0.4 to 0.6 of the character height	Not applicable.

Table 2. Font and text format display parameters

The VMS shall also be able to generate any combination of text and numerals, including standard punctuation and arrow display.

4.3.5 Default font formatting requirements

Default font settings shall be set and configured by the VMS as defined in this standard.
The expectation is that all requesting or setting entities (back-end systems and local controllers) will adhere to default font settings. This is to ensure that message formatting is consistent to all users regardless to who is setting the message.

5 DESIGN FOR SAFETY

This section defines the core requirements to ensure the intelligent transport system can be operated and serviced safely.

5.1 Health and safety

All ITS equipment must be designed to ensure installation and maintenance in accordance with the Health and Safety at Work Act 2015.

5.2 Safety conditions and obligations

Messages which are displayed on electronic signage present a mechanism to communicate with road network users. Therefore, messages must be visible and legible under all conditions – users shall be able to easily read and comprehend messages on electronic signs in order to be able to react appropriately and in a timely manner. In order to meet these requirements for road users the following rules shall be followed:

i. VMS and LCS must meet visibility requirements, as defined in the latest versions of ITS delivery specification: Variable Message Signs – Fixed and ITS delivery specification: Lane and Carriageway Signals respectively.
ii. All fonts must meet the visibility requirements of this standard, including font sizes and rules for composing words and messages.
iii. All electronic signs installed on NZ roads shall comply with TCD rule section 3.1 (c) electronic messages set on those signs shall convey a clear and consistent message to road users.

Any deviations from these requirements and any visual distractions associated with electronic signage may significantly affect the safety of road users.

6 DESIGN FOR MAINTAINABILITY

This section defines the core requirements to ensure the intelligent transport system can be maintained.

6.1 Maintenance conditions and obligations

Not applicable.

7 DESIGN FOR SECURITY

This section defines the core requirements to ensure the intelligent transport system can be secured and maintain integrity.

7.1 Security conditions and obligations

Not applicable.

8 APPENDIX A: WAKA KOTAHI FONT MAPS FOR STANDARD VMS AND LCS FONTS

This section contains Waka Kotahi font maps for standard fonts. A font map shows visual representation of a character on electronic sign using a sequence of illuminated pixels. Font maps include character dimensional and margin (required left and right spacing) information for VMS and LCS which comply the latest versions of ITS delivery specification: Variable message signs – fixed and ITS delivery specification: Lane and carriageway signals respectively.

Figures 3–5 below contain the closest approximation of dimensions provided in table 3 Standard alphabets spacing chart in Series D of AS 1744 – conversions of mm into pixels proportionally to the corresponding pixel pitch of four standard VMS signs. Figure 6 represents the font used on Urban type D VMS does not follow Series D of AS1744 requirements.

The character and stroke width, left and right margins (dark grey area on both side of the character) can be obtained from font maps as shown on the figure 2 below.

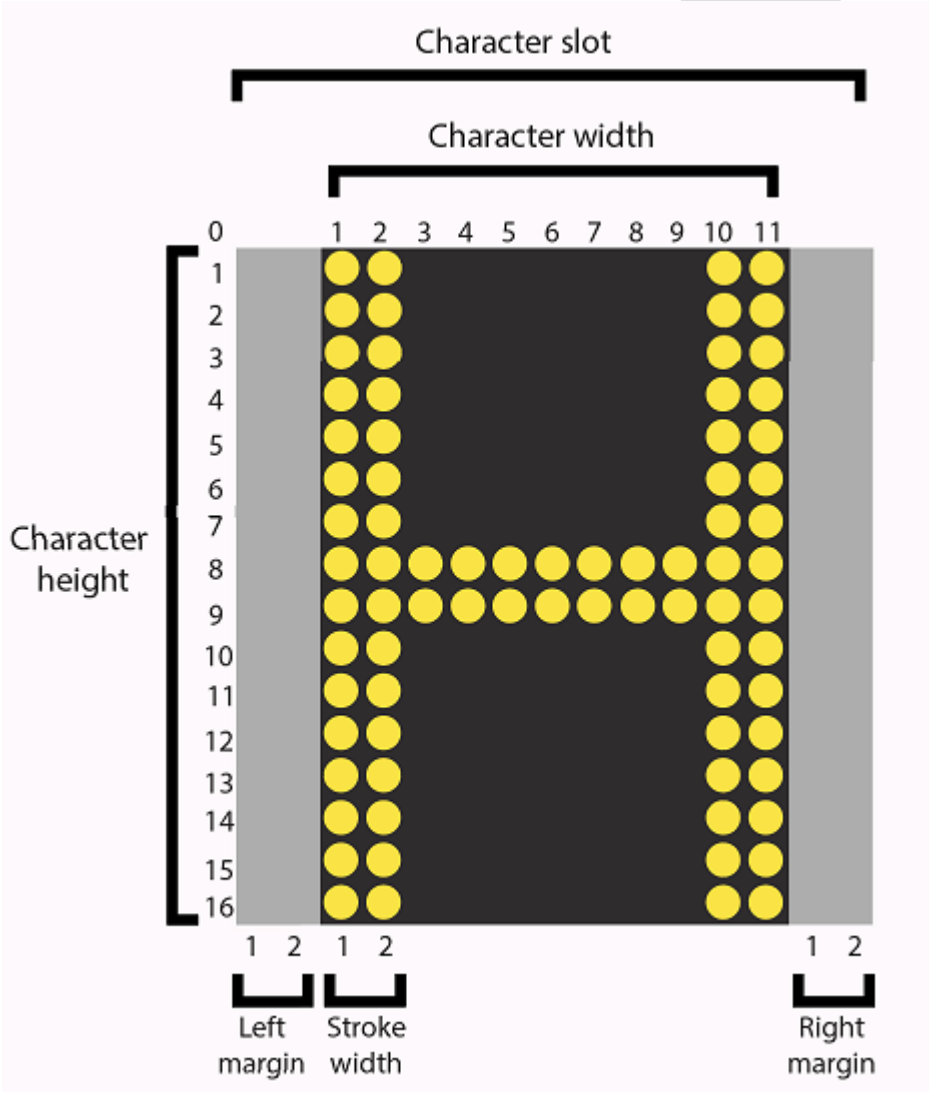


Figure 2. Example of typical features for dimensions of the character

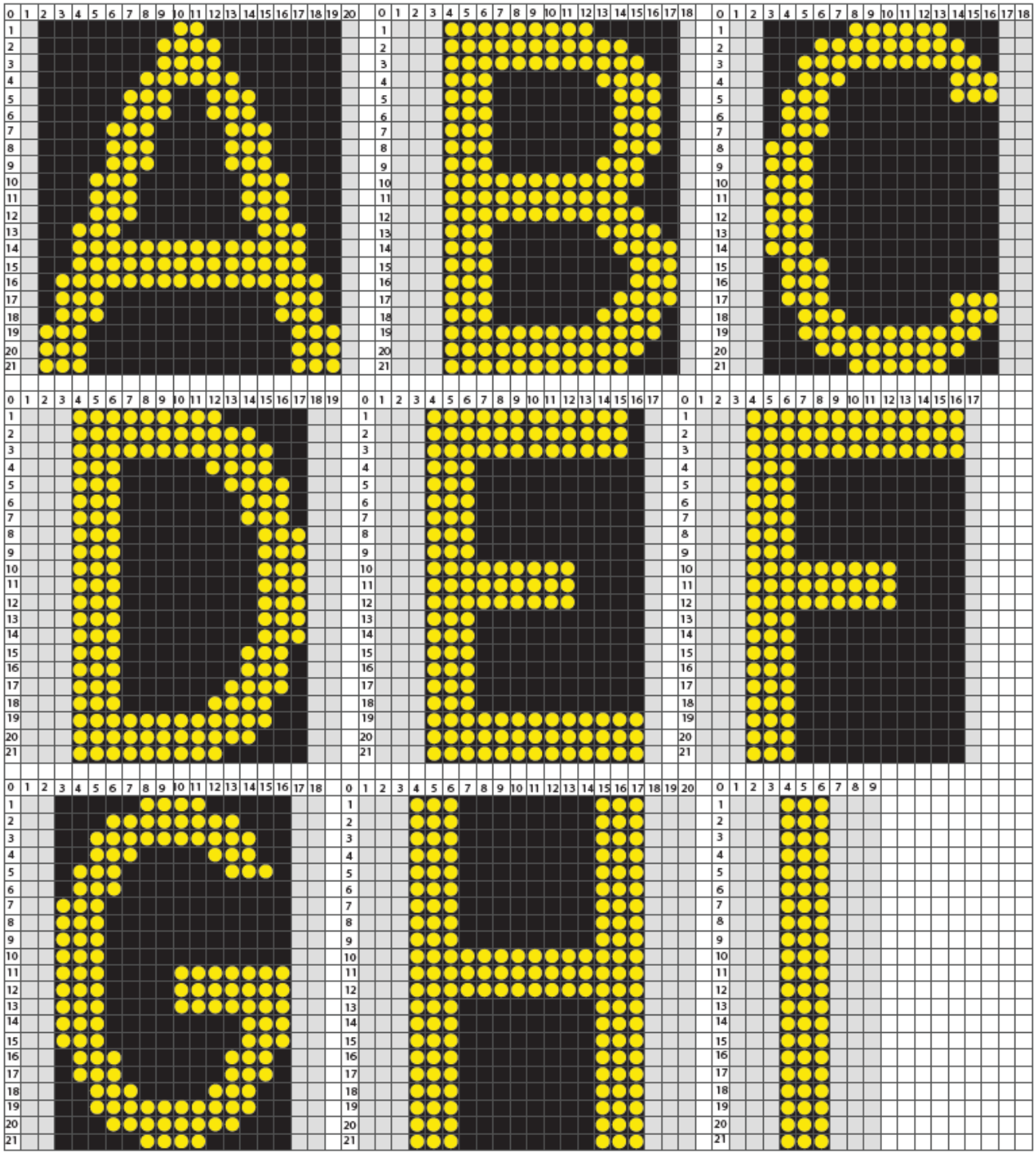
8.1 Motorway and expressway VMS – font maps

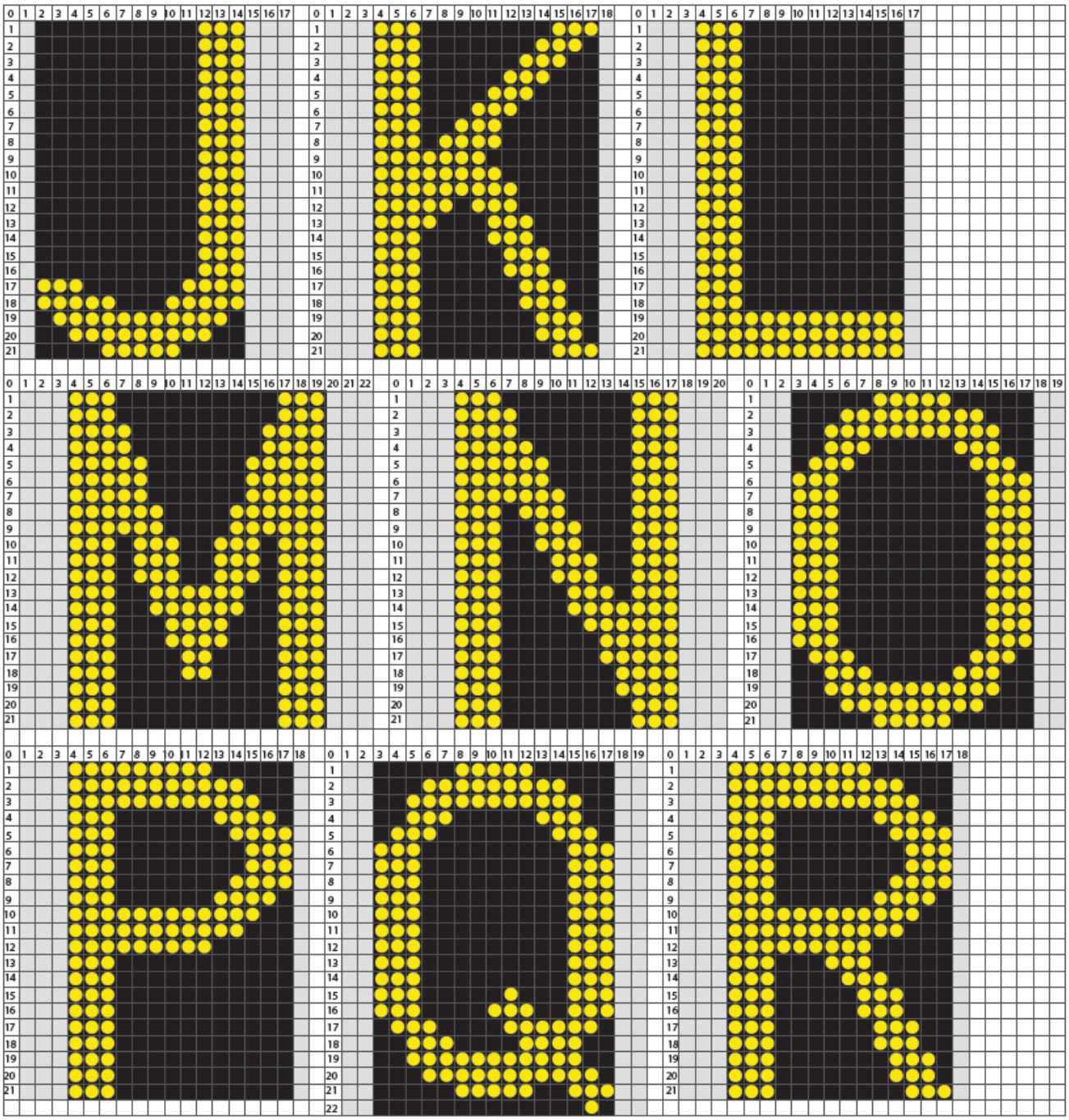
Motorway and expressway VMS (according to the latest version of ITS delivery specification: Variable message signs – fixed) have:

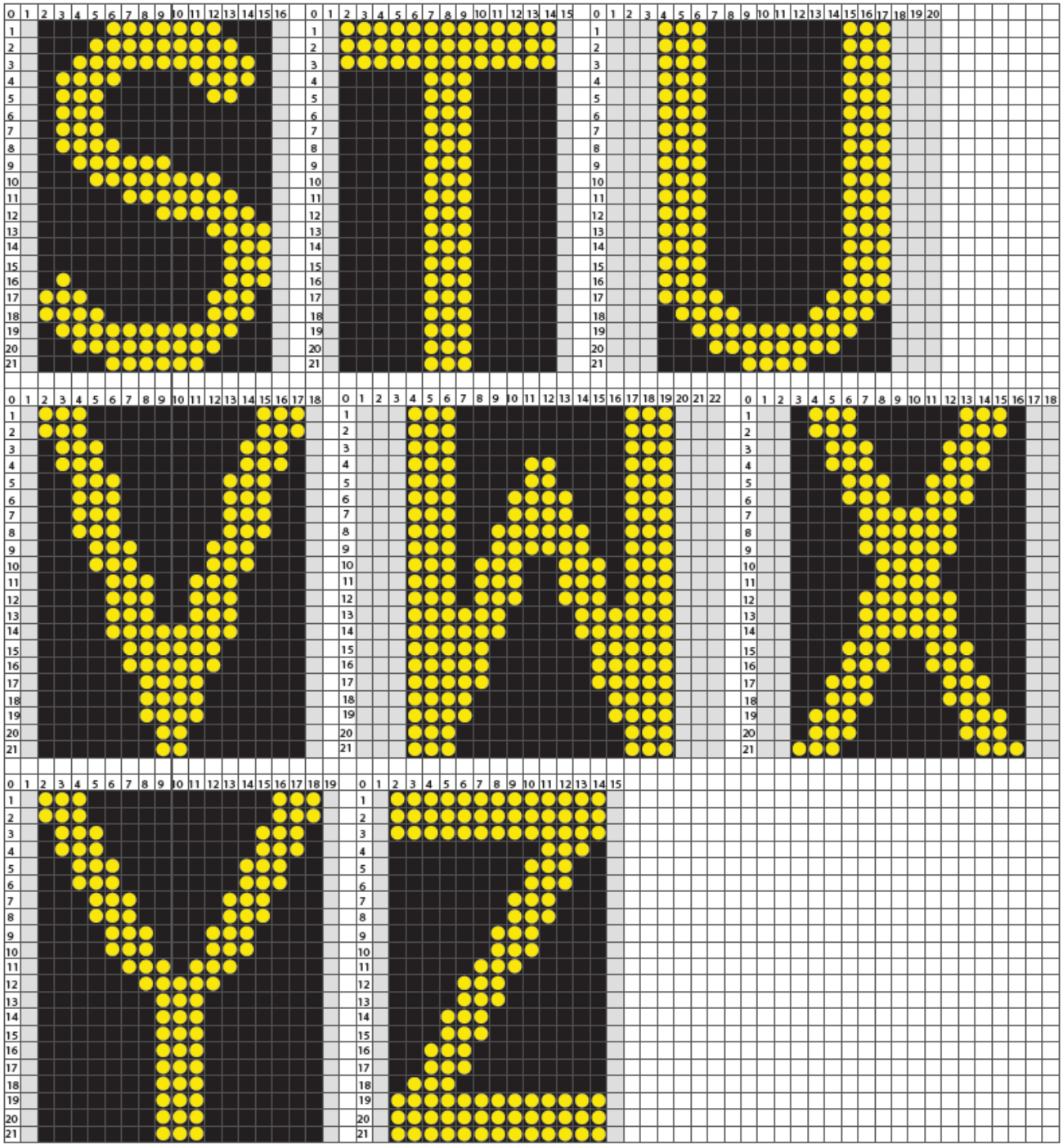
i. minimum of 352 pixels horizontally by 88 pixels vertically
ii. three lines of text
iii. maximum pixel pitch of 20mm
iv. minimum character height of 400mm or 21 pixels.

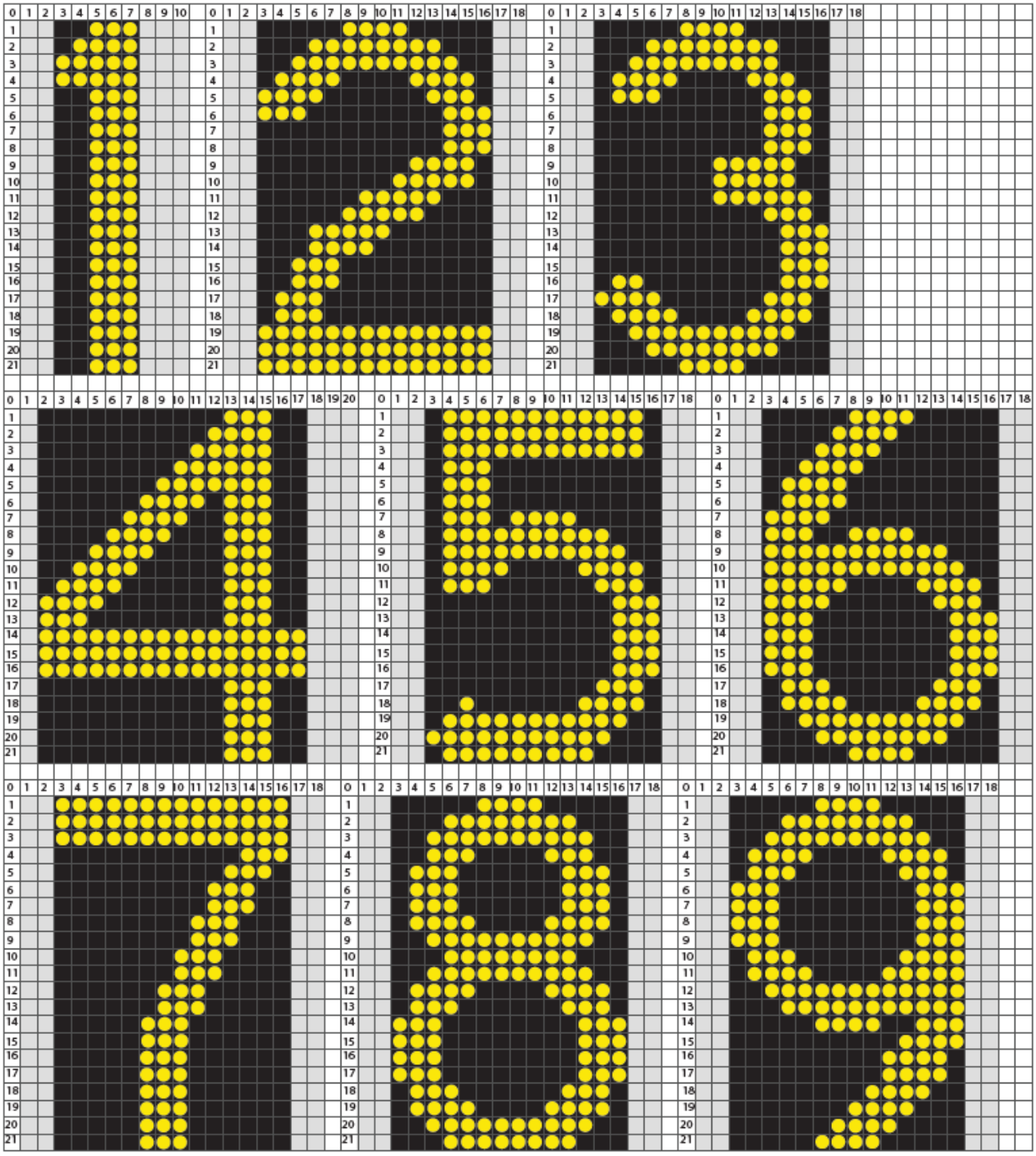
Line spacing for a 400mm-high font on motorway and expressway VMS is as follows:

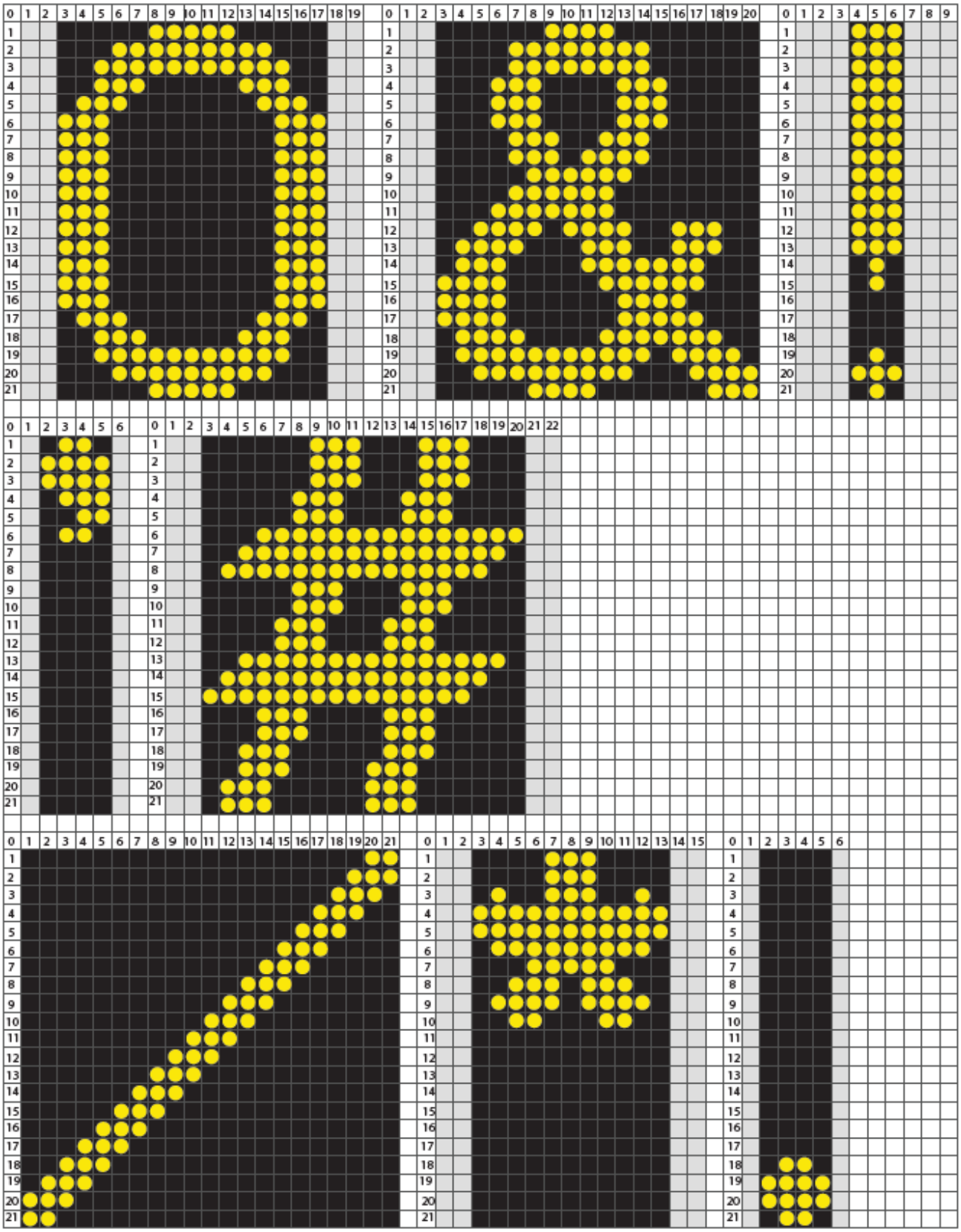
i. Above a line of text: 3 rows of unilluminated pixels.
ii. Below a line of text: 5 rows of unilluminated pixels.
iii. The last row of pixels at the bottom of the VMS display matrix shall be blank.

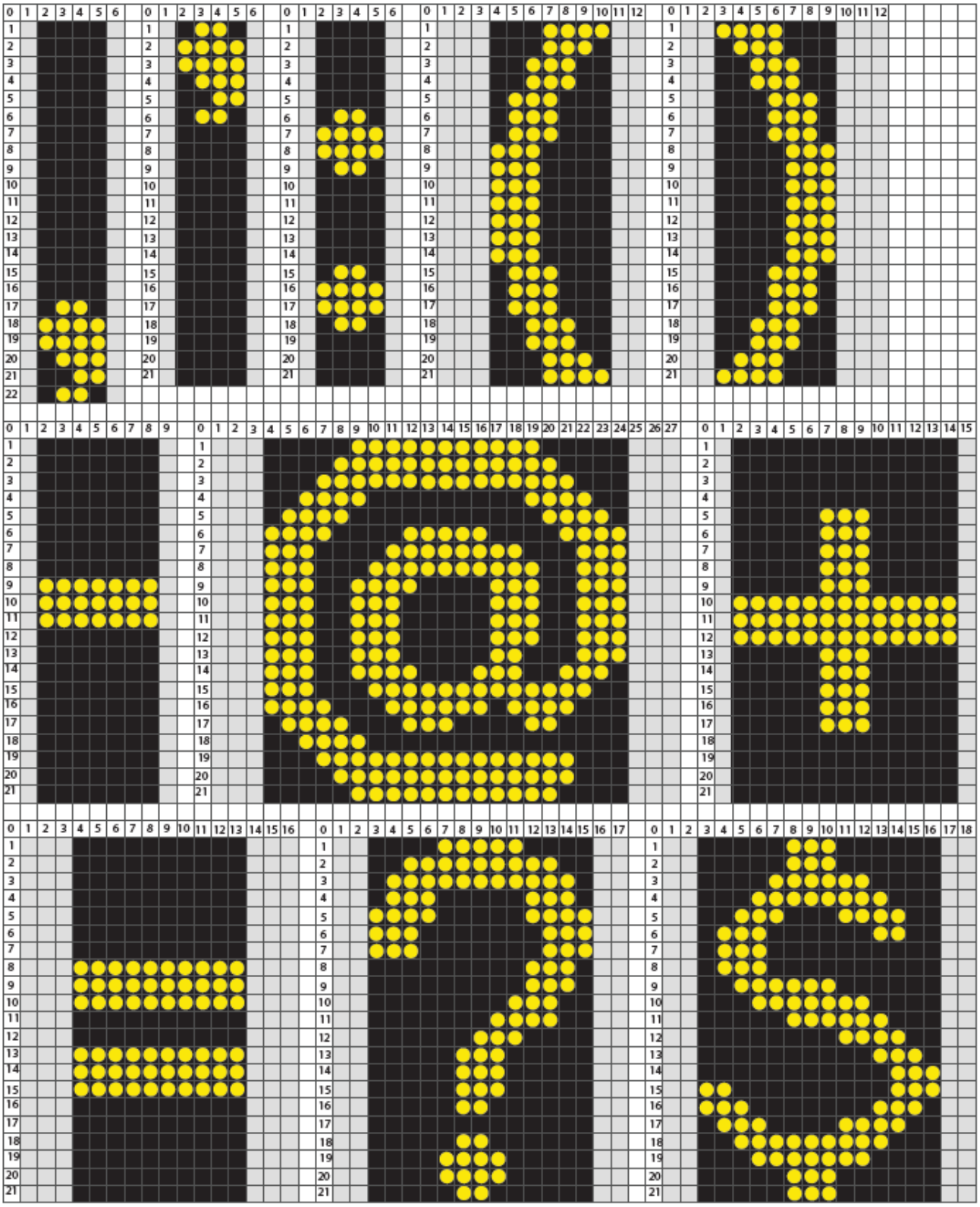












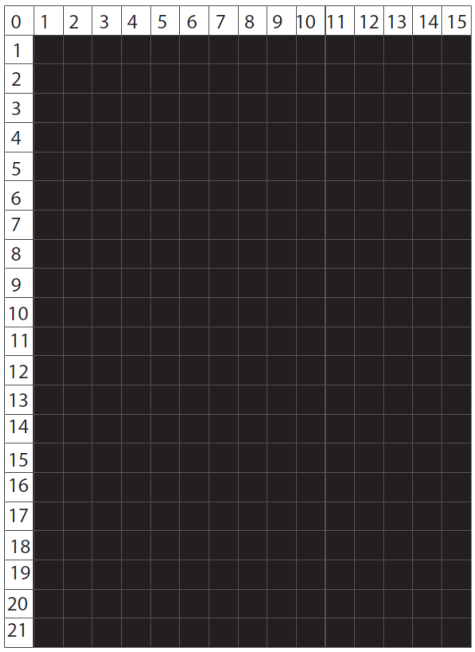


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Figure 3 Motorway and expressway VMS 400mm standard font maps

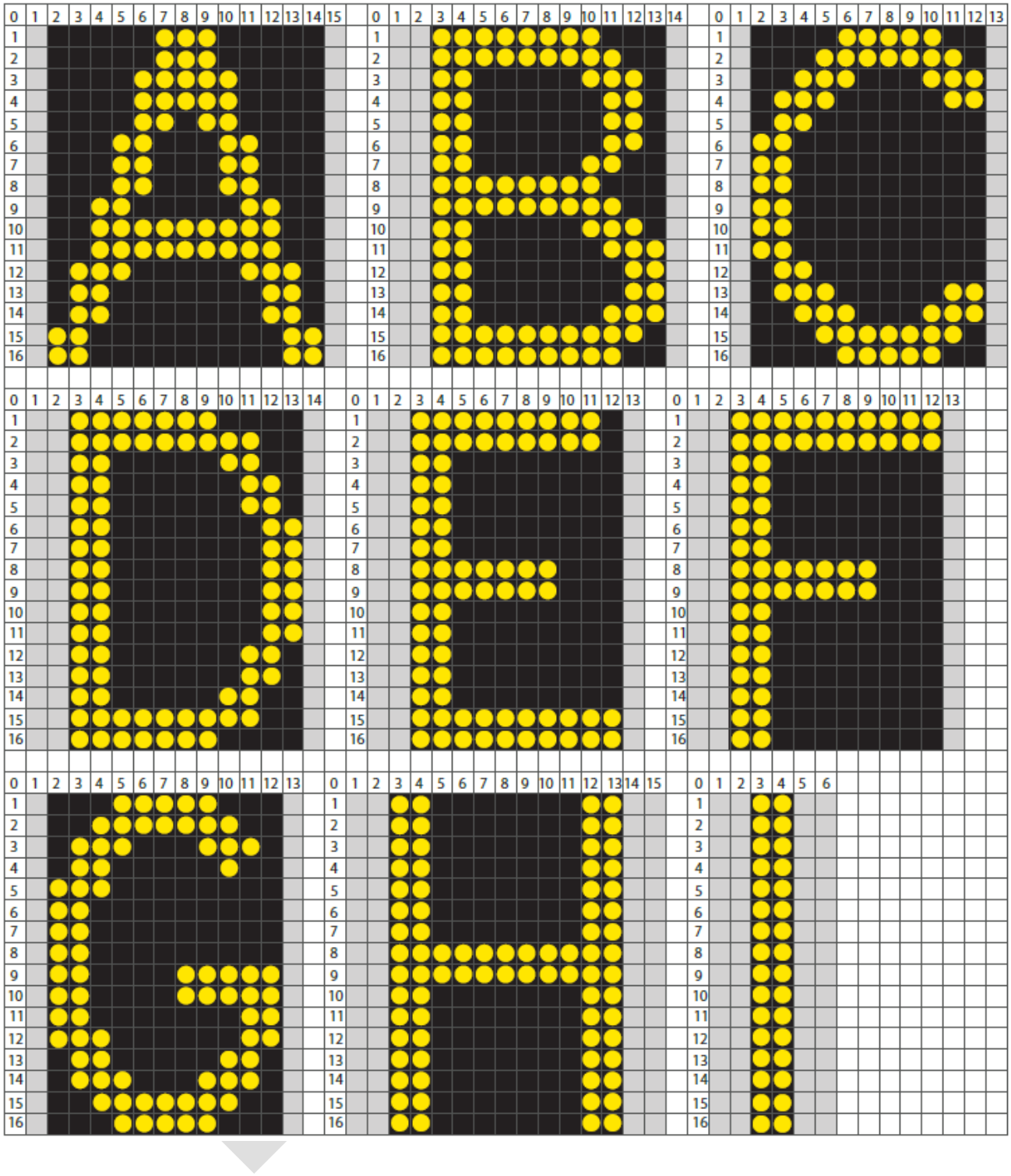
8.2 Regional type A VMS font maps

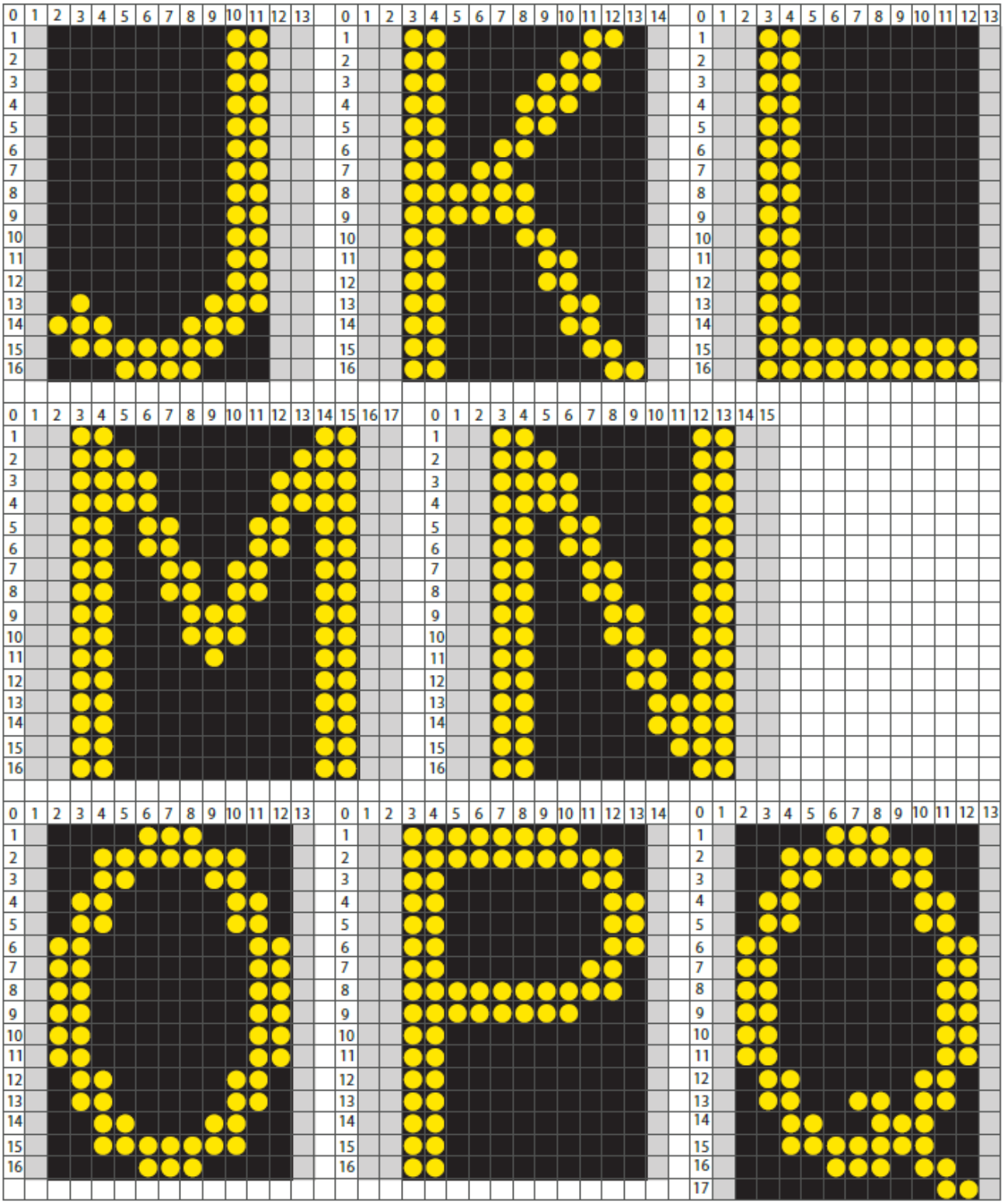
Regional type A VMS (according to the latest version of ITS delivery specification: Variable message signs – fixed) have:

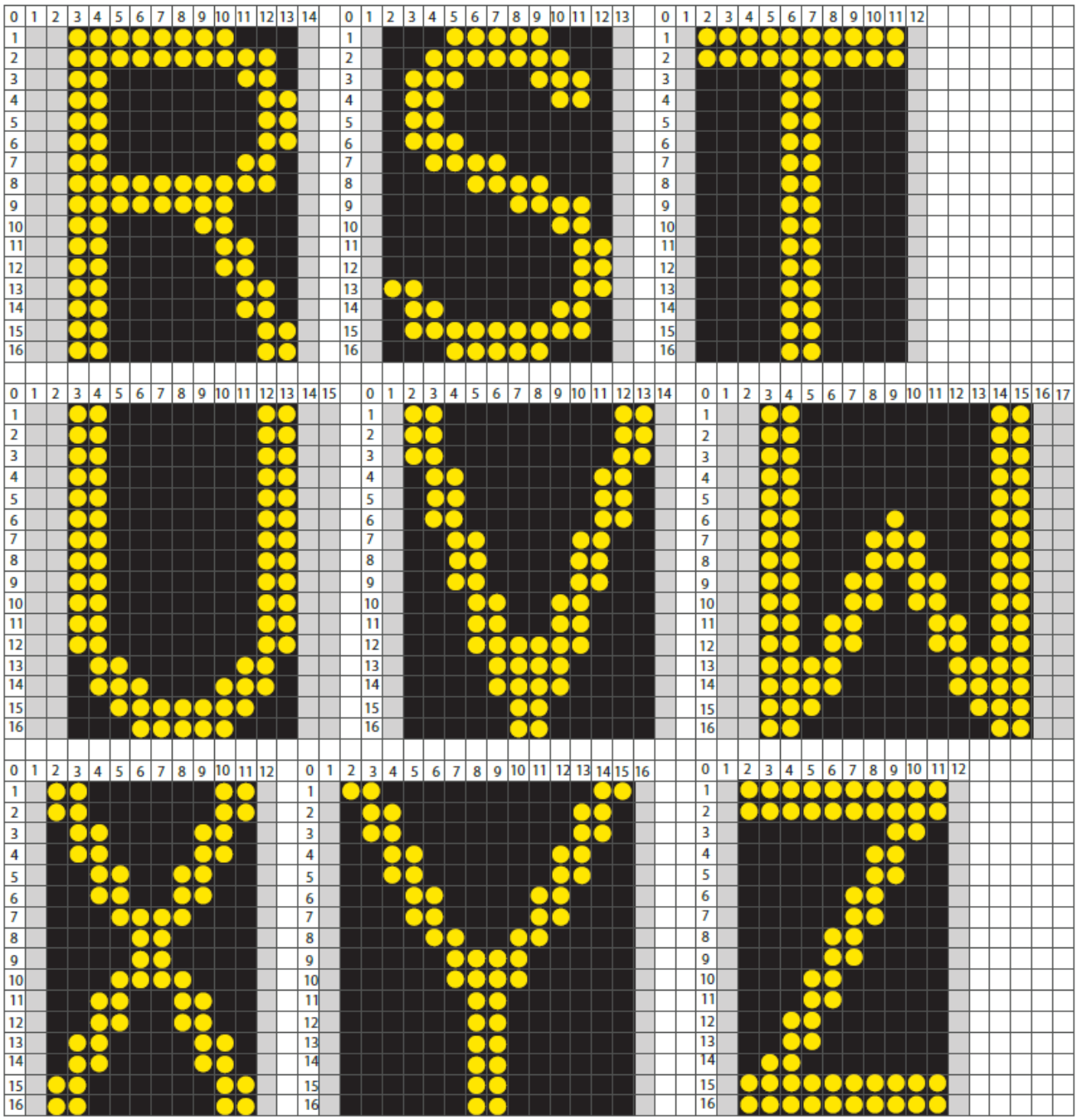
i. minimum 240 pixels horizontally by 104 pixels vertically
ii. four lines of text
iii. maximum pixel pitch of 20mm
iv. minimum character height of 300mm or 16 pixels.

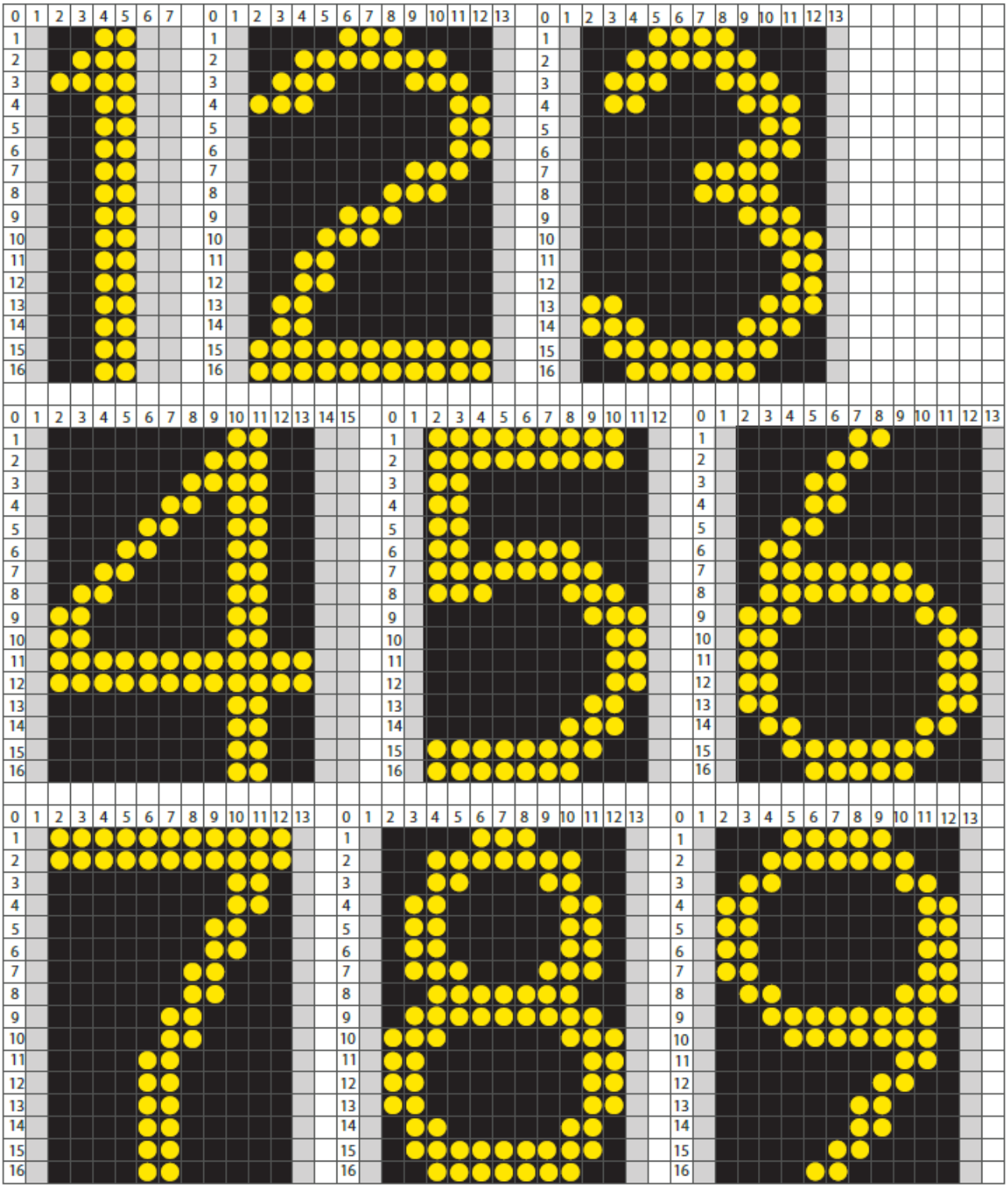
Line spacing for a 300mm-high font on regional type A VMS is as follows:

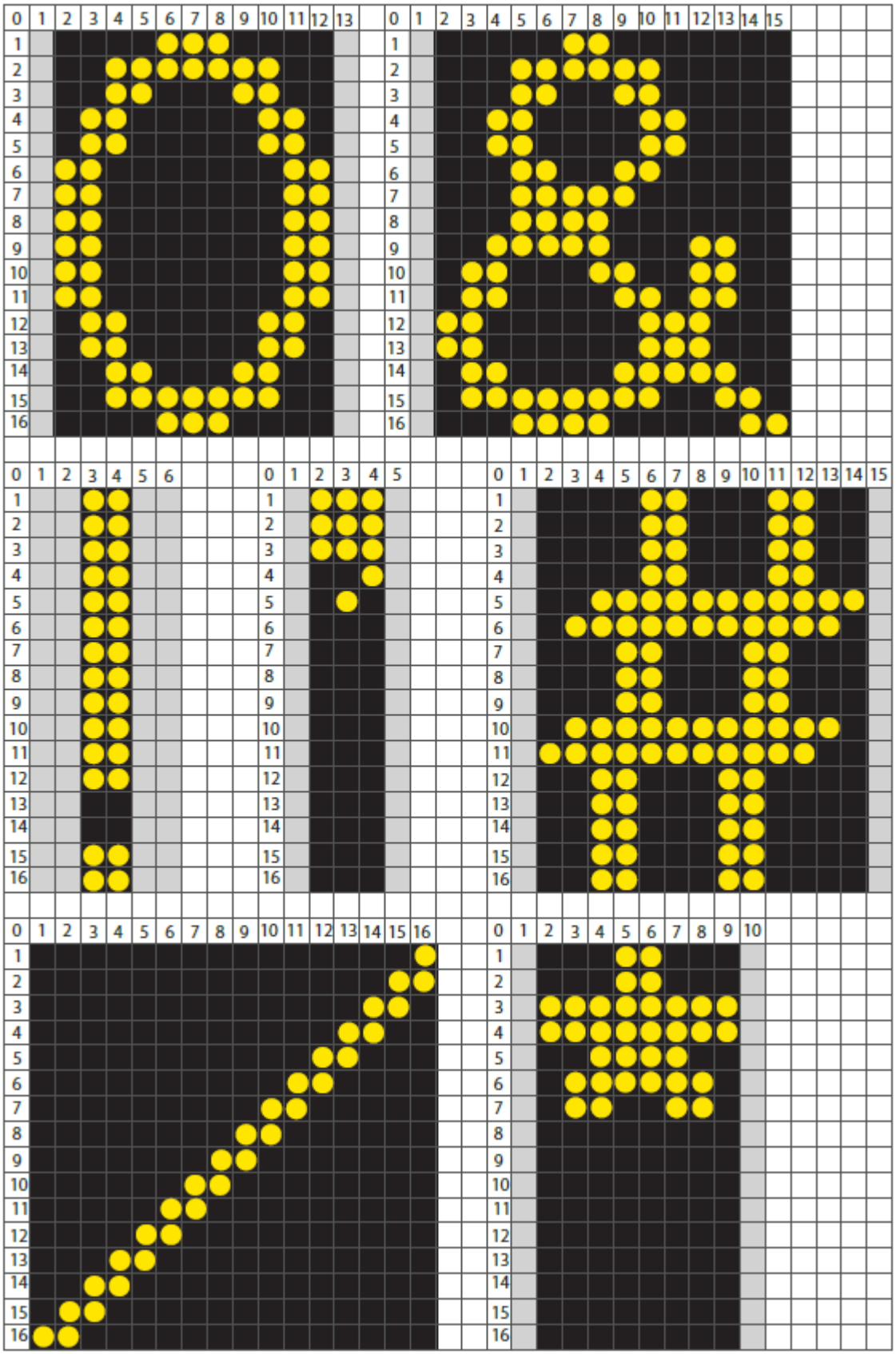
i. Above a line of text: 3 rows of unilluminated pixels.
ii. Below a line of text: 5 rows of unilluminated pixels.

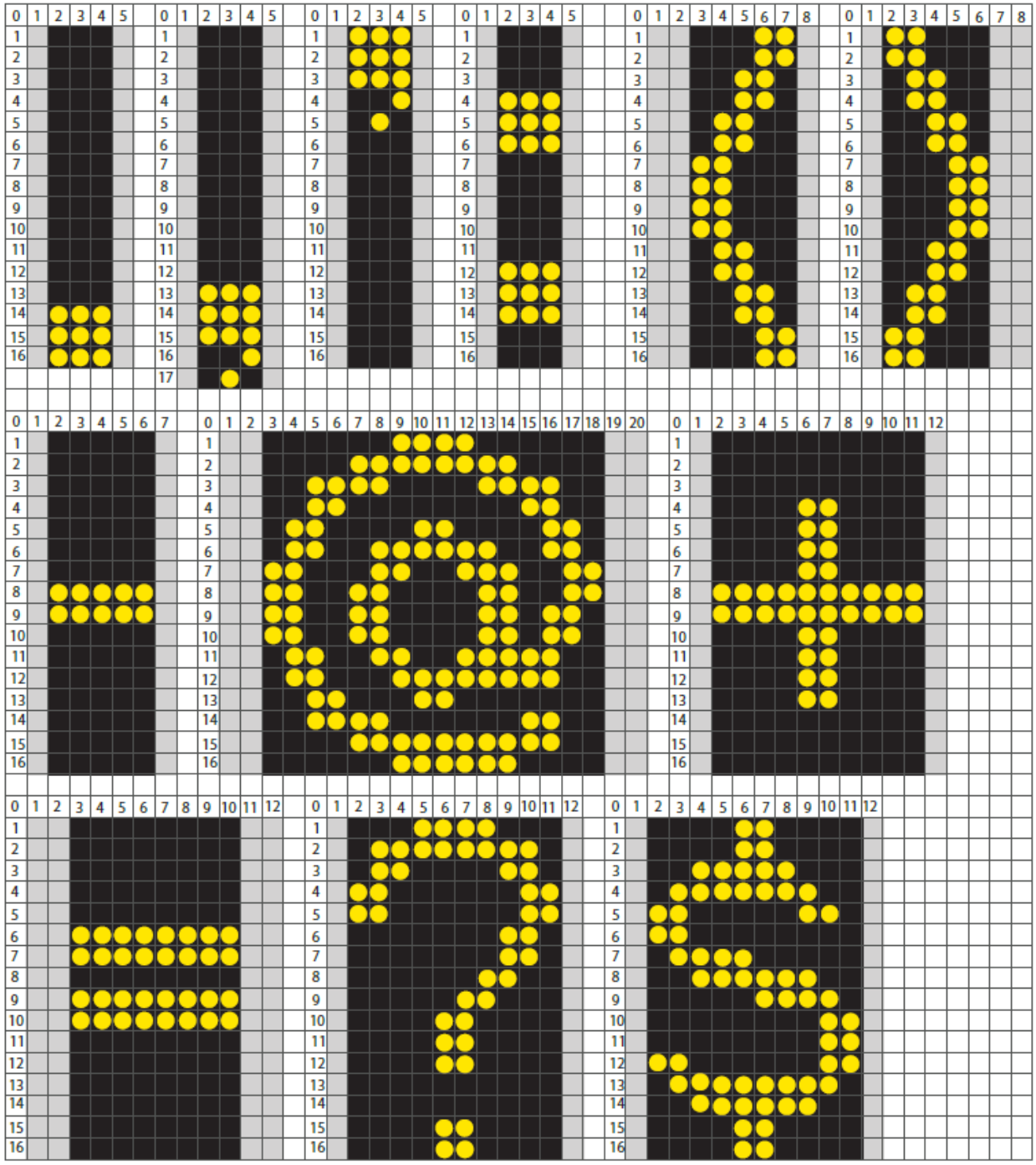












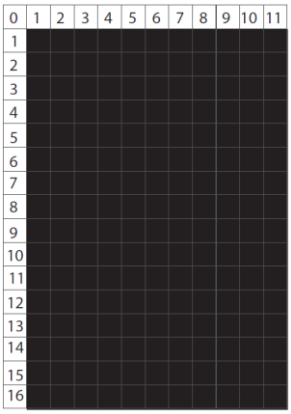


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Figure 4 Regional type A VMS 300mm standard font maps

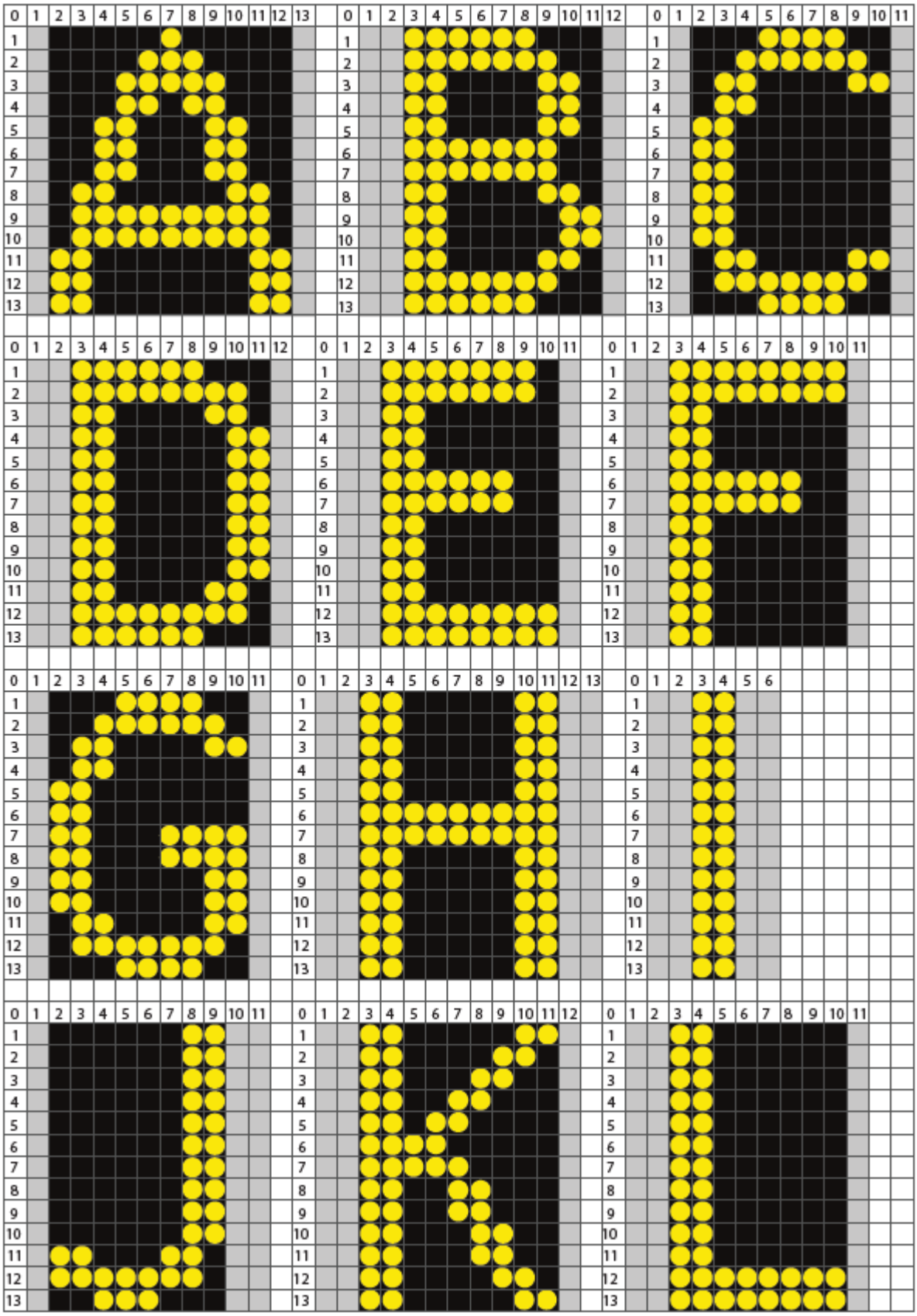
8.3 Regional type C VMS font maps

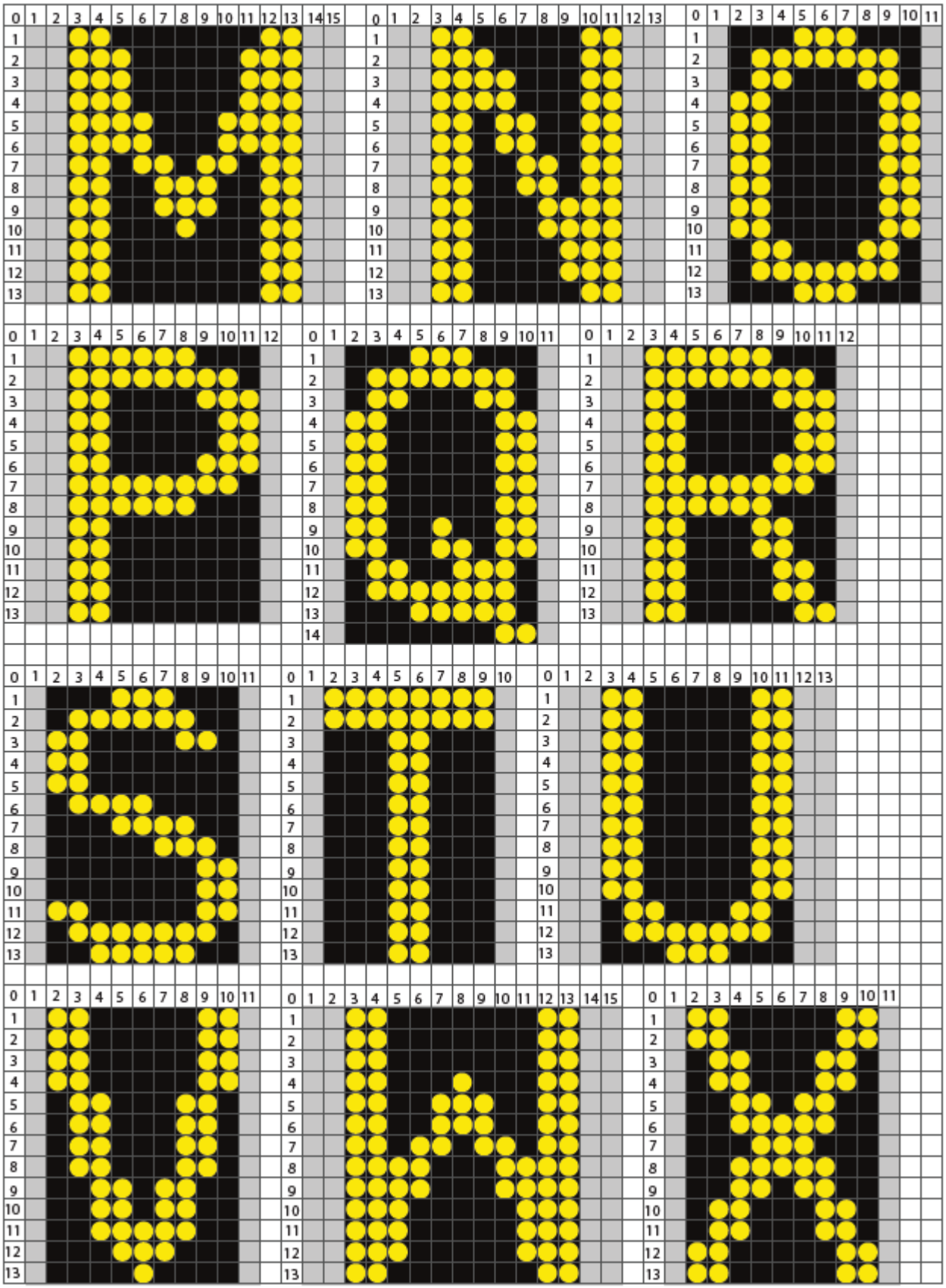
Regional type C VMS (according to the latest version of ITS delivery specification: Variable message signs – fixed) have:

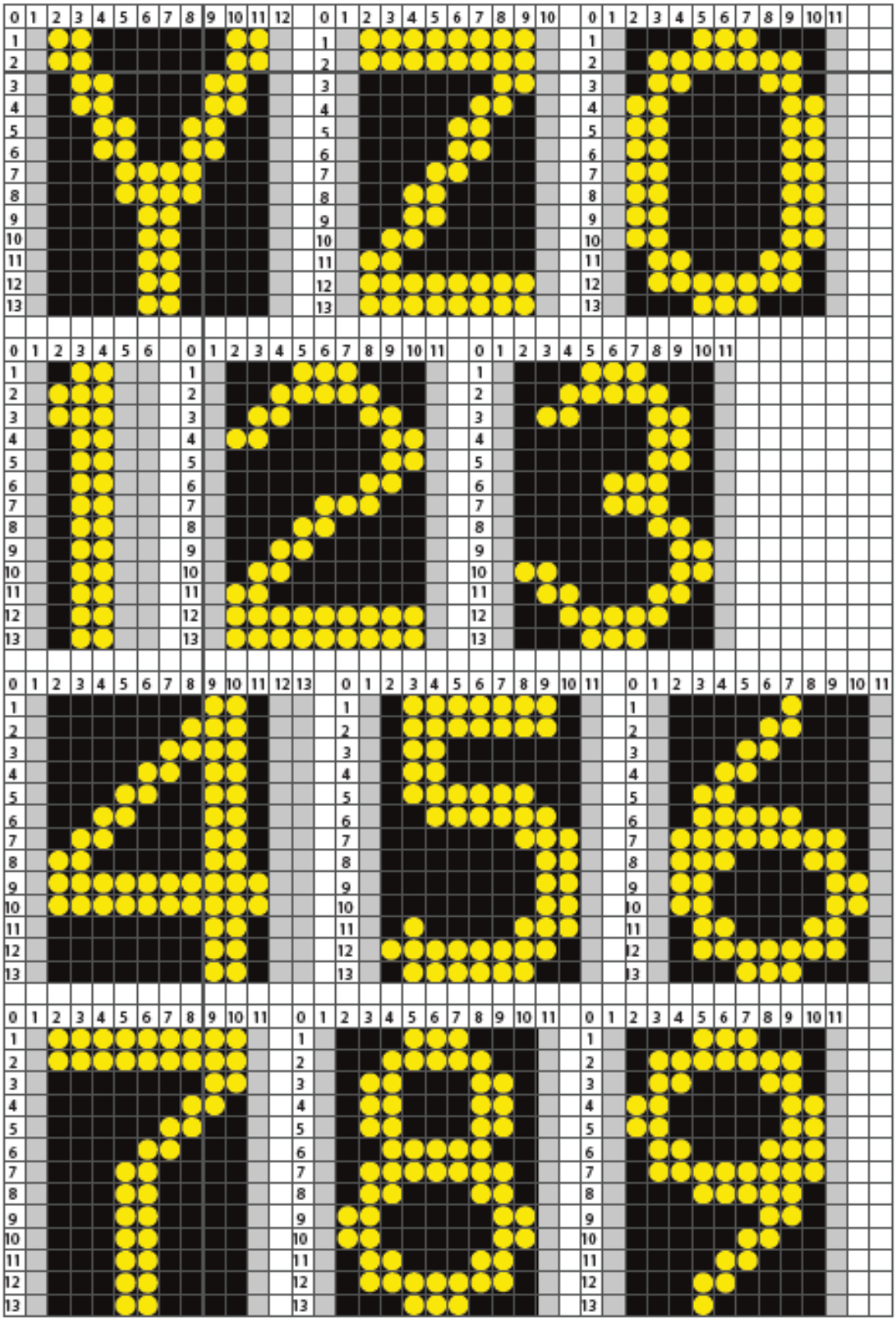
i. minimum 192 pixels horizontally by 80 pixels vertically
ii. four lines of text
iii. maximum pixel pitch of 16mm
iv. minimum character height of 200mm or 13 pixels.

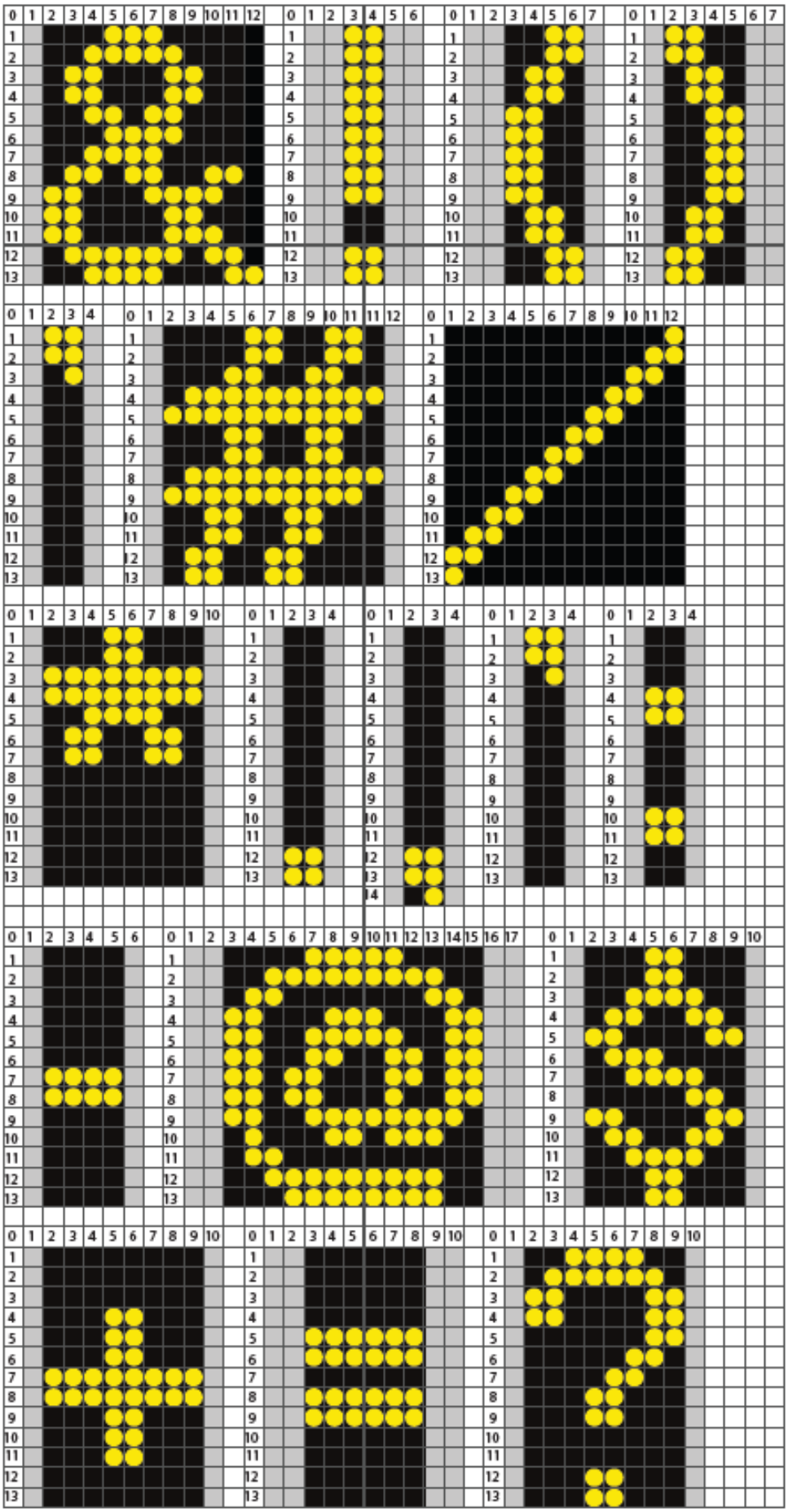
Line spacing for a 200mm-high font on regional type C VMS is as follows:

i. Above a line of text: 3 rows of unilluminated pixels.
ii. Below a line of text: 4 rows of unilluminated pixels









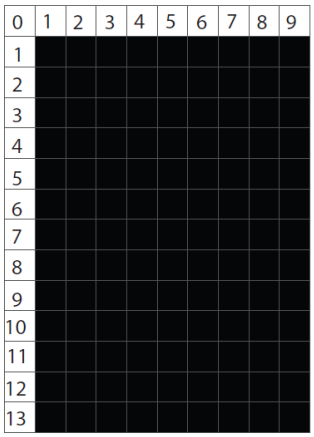


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Figure 5 Regional type C VMS 200mm standard font maps

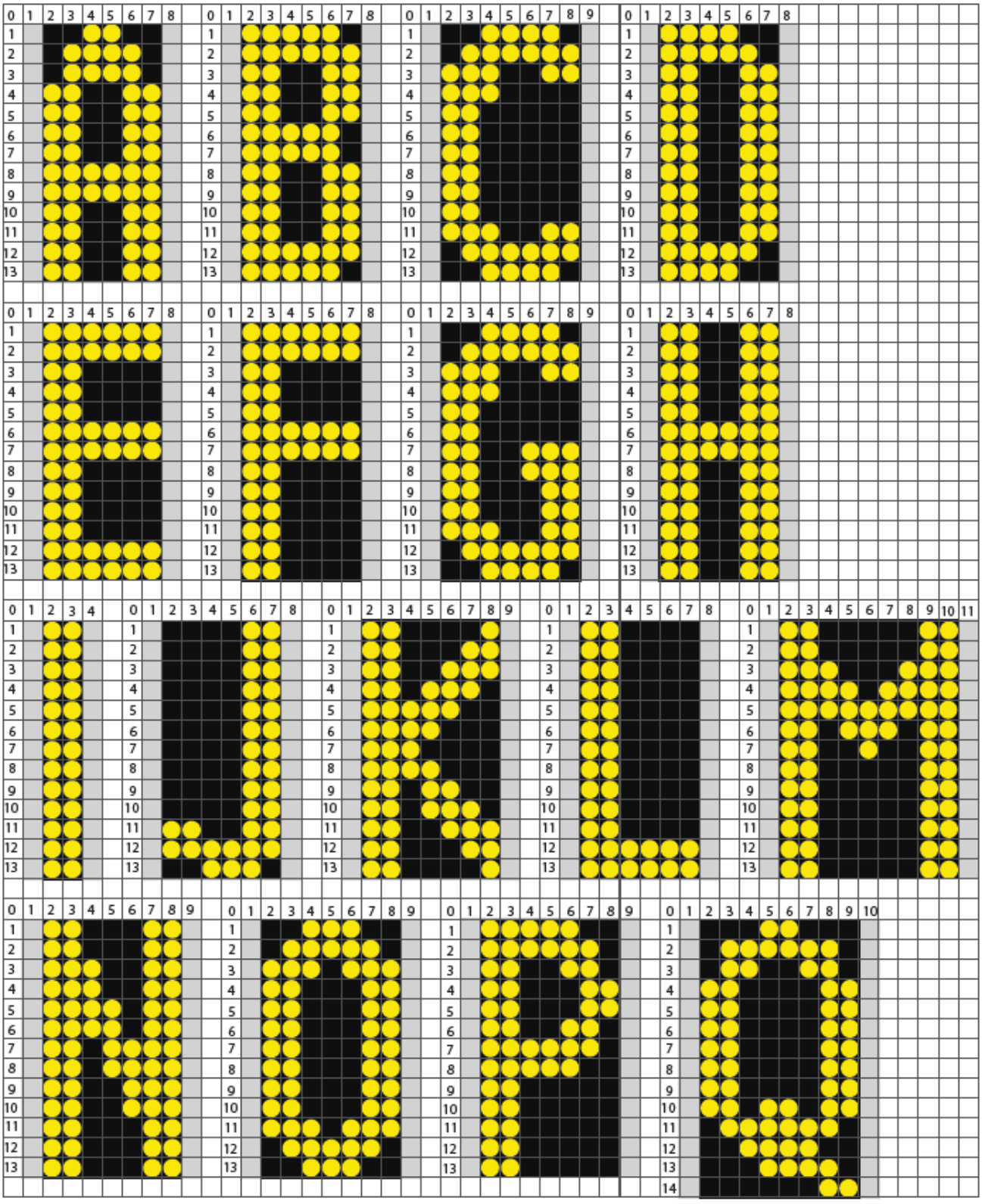
8.4 Urban type D VMS font maps

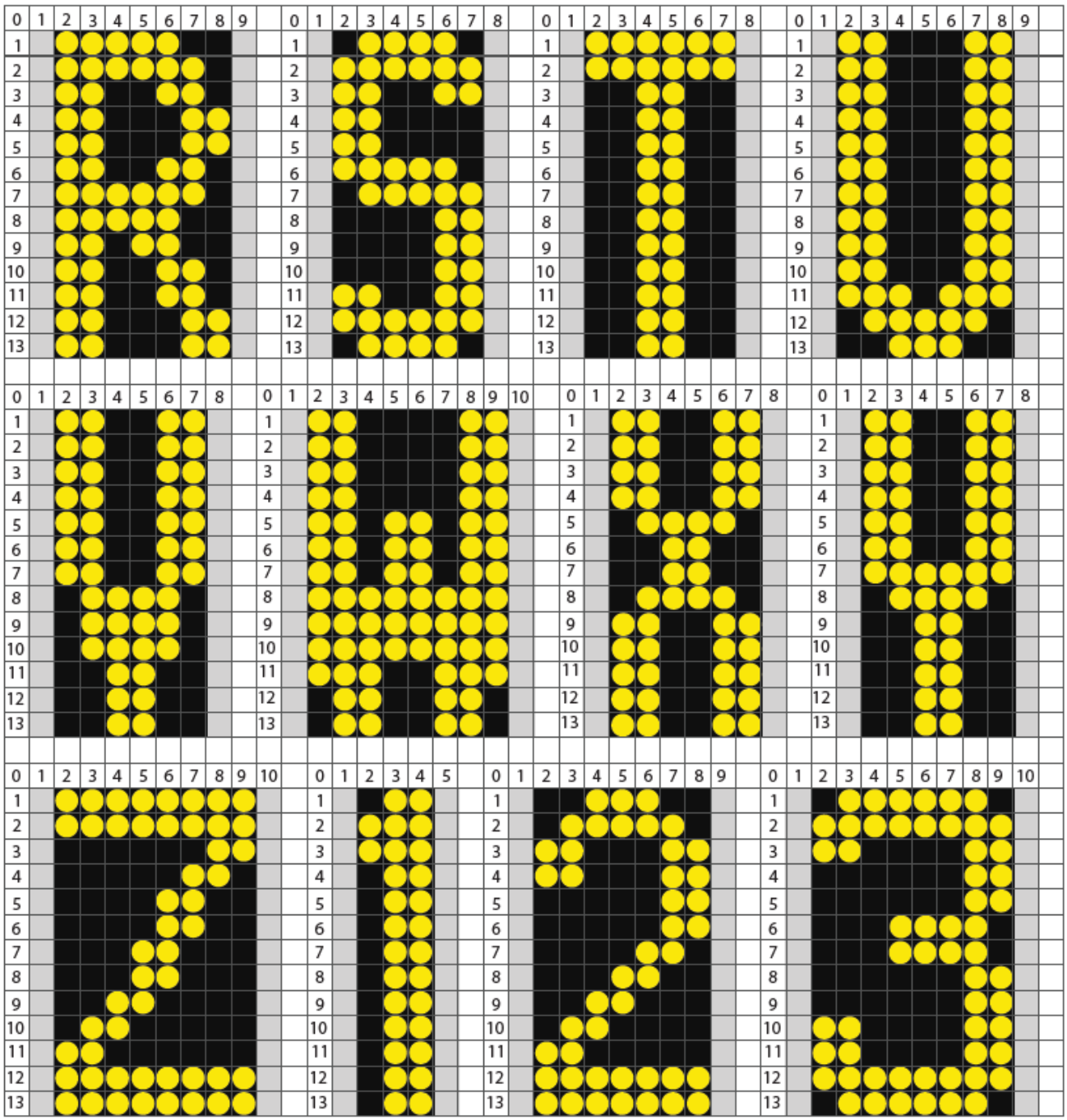
Urban type D VMS (according to the latest version of ITS delivery specification: Variable message signs – fixed) have:

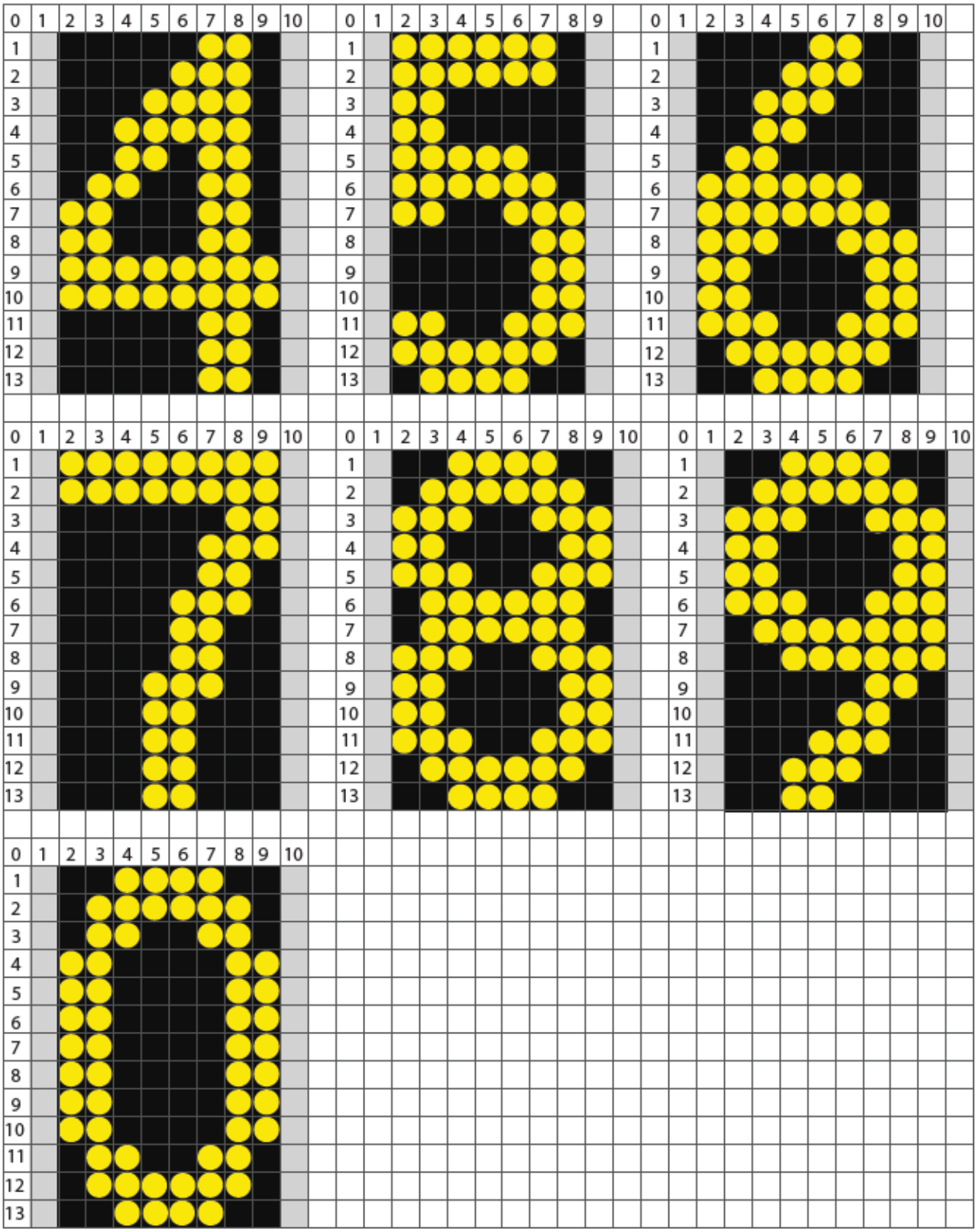
i. minimum 96 pixels horizontally by 56 pixels vertically
ii. three lines of text
iii. maximum pixel pitch of 16mm
iv. minimum character height of 200mm or 13 pixels.

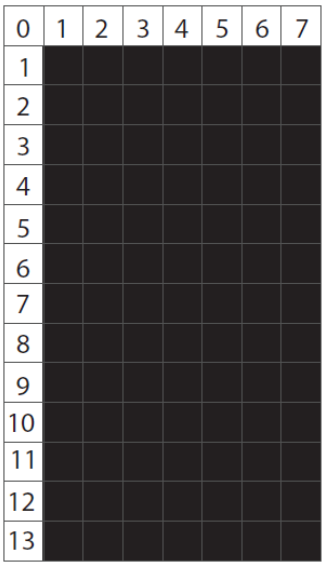
Line spacing for a 200mm-high font on urban type D VMS is as follows:

i. Above the first line of text: 2 rows of unilluminated pixels
ii. Above the second line of text: 6 rows of unilluminated pixels
iii. Above the third line of text: 6 rows of unilluminated pixels
iv. Below the third line of text: 3 rows of unilluminated pixels.









BLANK character

Figure 6 Urban type D VMS 200mm font maps

9 REFERENCES

This section lists all external and Waka Kotahi references included in this document.

9.1 Industry standards

Standard number / name	Source	Licence type and conditions
Health and Safety at Work Act 2015	NZ Legislation website	Publicly available
AS 1744:2015 Standard alphabet for road signs (Series D)	Standards Australia website	Available for purchase
UK Design Manual for Roads and Bridges 2002 – The Use of Variable Message Signs on All-Purpose and Motorway Trunk Roads (Volume 8, Section 2, Part 2 TD 33/05 Traffic Signs and Lighting – Signs and Road Markings – VMS – NI)	For a copy of this document, contact the ITS S&S team via email: itsspec@nzta.govt.nz	
Traffic Control Devices 2004. Rule 54002/2004 Updated 01 April 2022 (TCD rule)	New Zealand Transport Agency website	

9.2 Waka Kotahi standards, specifications and resources

9.2.1 Standards and specifications

See the Waka Kotahi website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name
ITS design standard: Variable message signs – fixed
ITS delivery specification: Variable message signs – fixed
ITS delivery specification: Lane and carriageway signals

9.2.2 Resources

Document name / code	Waka Kotahi website link

10 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class
3.2.1	Definition	Variable message signs – fixed delivery specification	001 Signs

11 FULL VERSION HISTORY

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or if it's a major update 2.0, and so on.

Version	Date	Author	Role and organisation	Reason
0.1	17/06/2022	Kirill Yushenko	Principal ITS Consultant, Resolve Group	First draft
0.2	15/07/2022	Final Word	Editorial services	Proofread first draft
0.3	16/08/2022	Kirill Yushenko	Principal ITS Consultant, Resolve Group	Addressed proofer's first draft comments, and comments from Ian Leach and Russell Pinchen
0.4	23.08.2022	Final Word	Editorial services	Proofread/update per author changes in version 0.3, further queries for author and Waka Kotahi
0.5	24.08.2022	Anandita Pujara	Document Manager	Added notes and comments to queries from proofer and author. Added content to be redirected
0.6	19/09/2022	Final Word	Editorial services	Update per author and Waka Kotahi answers to queries
0.7	22/11/2022	Kirill Yushenko	Principal ITS Consultant, Resolve Group	Implemented changed agreed post Expert review workshop
0.8	23/03/2022	Anandita Pujara	Document Manager	Updates made to link the document to SM0 series