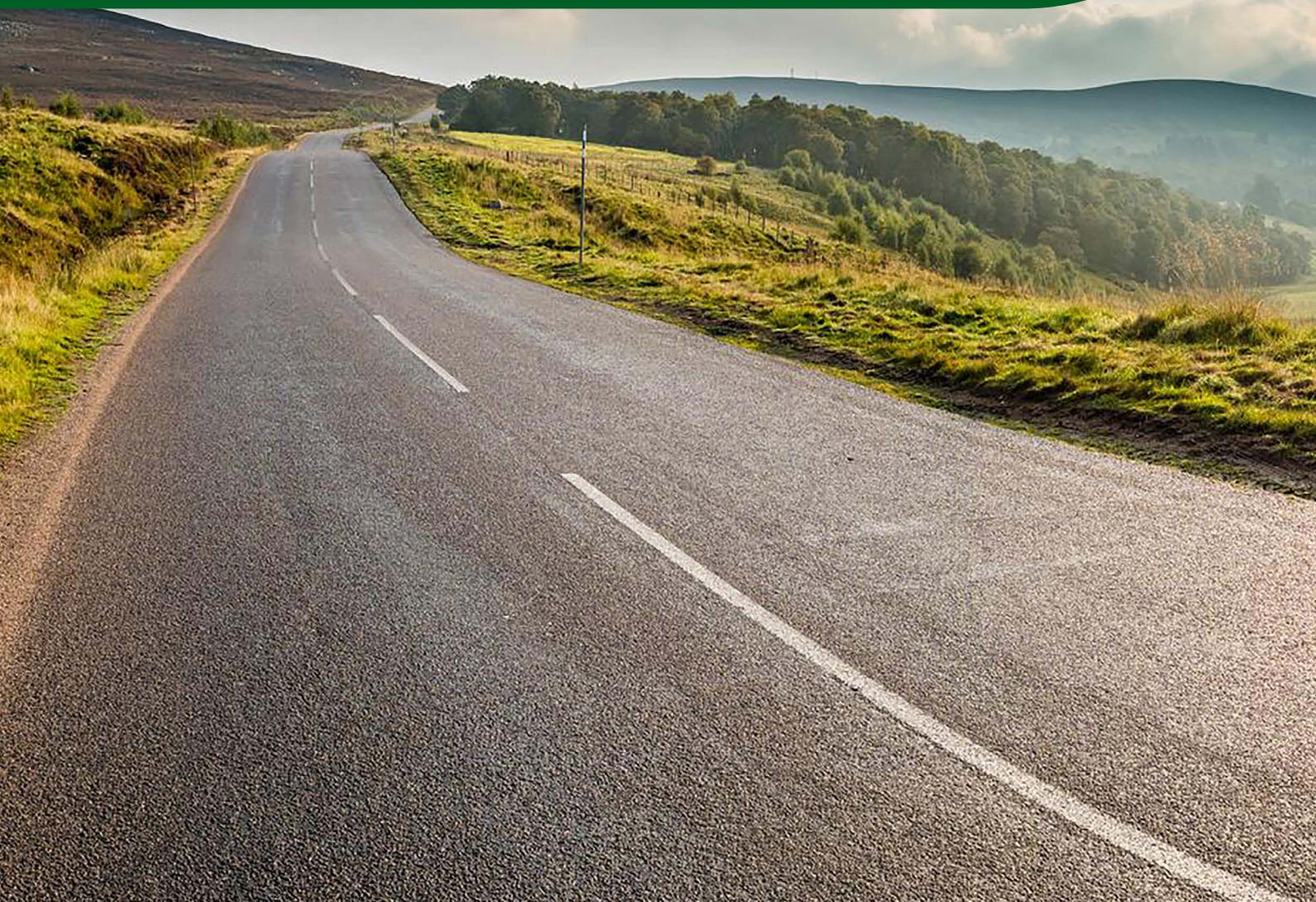


PAS 2161:2024

Road condition monitoring (RCM) data – Specification



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Foreword

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Presentational conventions

The provisions of this document are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. "organization" rather than "organisation").

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In particular, attention is drawn to the following specific Acts and regulations:

- Traffic Management Act 2004 [1];
- Highways Act 1980 [2];
- Local Government Act 2000 [3];
- Construction (Design and Management) Regulations 2015 [4];
- Road Traffic Act 1988 [5];
- Road Traffic Regulation Act 1984 [6]; and
- Data Protection Act 2018 [7].

0 Introduction

0.1 Background

Road condition monitoring (RCM) data are an important component of the information used by Highway Authorities to understand and manage the condition of their networks. Data can be used to report the overall condition of road networks, through the application of indicators and network-wide statistics. Data can also be used to identify lengths in need of investigation for maintenance and, where the data contain a sufficient level of detail, can be applied to aid in deciding on the treatments required.

The focus of this PAS is to specify the requirements for RCM data for the purpose of reporting categories of road condition. Although these are the categories required for national reporting, they can also be applied by Highway Authorities for the purposes of wider road asset management. However, as the application of RCM data for road asset management varies by authority, according to their local approach to the management of road assets, the PAS does not specify requirements for asset management purposes, but does provide some guidance on this topic.

This PAS aims to specify requirements for those involved in the collection, procurement and application of RCM data, in relation to:

- a) establishing categories of condition for road networks;
- b) adopting a consistent approach to RCM data capture, processing and reporting;
- c) classifying the types of technology applied in the collection of RCM data;
- d) national reporting of condition categories;
- e) standardizing the format of the deliverables for national reporting; and
- f) demonstrating the capability of RCM technologies to report condition categories.

0.2 Collecting data and reporting road condition

In this PAS, it is assumed that Highway Authorities are the key recipients of RCM data that are collected to support understanding and managing the condition of their road networks, and for national reporting. The PAS assumes that Highway Authorities have established definitions for their networks, including road types and classifications (or have the ability to do so), and can make these accessible to providers of RCM data collection technologies, RCM data management systems and RCM data, as appropriate. This PAS also specifies activities for processing and validation of the data collected, which include checks on fitting of RCM data to the network, quality checks, and formatting for national reporting (a worked example of a data file is provided in Annex A). It is assumed that there is an appropriate understanding of, and capability to carry out, these activities by those collecting, processing and using RCM data.

0.3 RCM condition categories and additional data

In this PAS, condition categories are defined in terms of the maintenance treatment option that would be selected by a typical Highway Authority engineer to restore a length that has deteriorated to a condition such that the engineer would no longer consider the length for maintenance (see Clause 5). This “end-result” approach does not require RCM data providers to report specific defects or condition parameters, so this PAS does not provide defect definitions or a defect catalogue. This approach enables RCM providers to innovate, and to determine themselves the technology and the methodology they use to report road condition categories.

However, while condition categories relating to maintenance treatment options are used for national reporting, this does not prevent Highway Authorities from obtaining defect (or condition parameter) data for local application within their asset management process. These data are called “additional data” in this PAS. The PAS provides information on the potential for broader collection and application of condition category and additional data by Highway Authorities (see Annex B).

0.4 Types of technology providing RCM data

This PAS does not require the use of a specific type of technology for the collection of RCM data. Furthermore, Highway Authorities are not required to use the same types of technology for all parts of their network.

However, as many different technologies are available, for clarity, this PAS categorizes various types of technology that can be deployed for the collection of RCM data in terms of:

- a) the method used for the collection of RCM data; and

***NOTE 1** Several types of RCM technology are defined which deploy different approaches. Highway Authorities may select whichever technologies are most suited to their needs.*

- b) demonstration of capability of the RCM technologies.

***NOTE 2** An approach is defined for demonstrating the capability of RCM technologies to report condition categories. While Highway Authorities can select the technologies most suited to their requirements, there is a need for RCM technologies providing data for national reporting to have demonstrated their capability.*

0.5 Using PAS 2161

Guidance is provided in Table 1 to assist in navigating the clauses of this PAS, and the implications of each clause for the collection of RCM data.

Table 1 – Using PAS 2161

Clause number	Clause title	Purpose of clause
1	Scope	To establish the overall content of this PAS, and to whom the PAS applies.
3	Terms, definitions and abbreviated terms	To establish the terms and abbreviated terms used in the PAS.
4	RCM data collection	To establish the general requirements and responsibilities of a Highway Authority for defining the network on which RCM data are to be collected, and for commissioning an RCM data collector to provide this data. To establish the general requirements and responsibilities of the RCM data collector and RCM data processor for the collection, validation and fitting of RCM data to this network. <i>NOTE 1 The requirements in Clause 4 apply for all types of RCM data collection and are not specific to the collection of data for national reporting. Requirements for national reporting are in Clause 8.</i>
5	RCM data	To establish how RCM condition categories are defined, and the RCM data that might be provided, in addition to condition categories to support local asset management.
6	RCM technology type	To establish the types of technologies that can be used for the collection of RCM data.
7	RCM data processing and reporting	To establish the specific requirements and responsibilities of the RCM data collector and RCM data processor when validating RCM data, fitting RCM data to the network, and reporting RCM data in the required format. <i>NOTE 2 The requirements in Clause 7 apply for all types of RCM data collection and are not specific to the collection of data for national reporting.</i>
8	Collection and reporting of RCM data collection for national reporting	To establish the specific requirements and responsibilities of the Highway Authority for establishing the lengths over which RCM data are to be collected for national reporting. This establishes the monitored network. To establish the specific requirements and responsibilities of the RCM data collector and RCM data processor for the collection, validation, fitting and reporting of data for national reporting on the monitored network. <i>NOTE 3 The requirements for national reporting in Clause 8 apply in addition to the requirements in Clause 4 and Clause 7.</i>
9	Consistency of RCM data	To establish how the capability of any RCM technology to report condition categories is to be demonstrated.

Figure 1 provides further general guidance for Highway Authorities on undertaking RCM data collection on their networks.

Figure 1 – Flow chart illustrating the general process for collection of RCM data



NOTE This figure shows a general process only, to assist in placing the clauses of the PAS into the context of a data collection, processing and reporting regime. Individual Highway Authorities need to meet the requirements when collecting their RCM data.

1 Scope

This PAS specifies:

- a) requirements for categories for the reporting of road condition;
- b) requirements for processing, validating and fitting road condition category data;
- c) network coverage requirements for national reporting of road condition categories;
- d) frequency requirements for national reporting of road condition categories;

NOTE 1 *Attention is drawn to the UK Government Single Data List (see <https://www.gov.uk/government/publications/single-data-list>), which sets out the latest requirements for Highway Authorities, and to separate guidance issued by the Department for Transport (see <https://www.gov.uk/government/organisations/department-for-transport>).*

- e) the format for road condition category data which are used for national reporting; and
- f) requirements for demonstrating the consistency of national reporting of road condition categories provided by road condition monitoring (RCM) technologies.

This PAS does not specify the technologies to be used for the collection and reporting of RCM data, but does discuss the different types of technology.

This PAS also provides optional recommendations for the use of RCM data to support the management of local road assets.

This PAS is applicable to classified (M, A, B, C) and unclassified (U) roads in England that are managed by local authorities.

This PAS is of use to the providers, procurers and users of RCM data collection technologies, RCM data management systems and RCM data.

This PAS might also be of interest to any other parties concerned with RCM data.

NOTE 2 *Although this PAS is primarily concerned with the collection and provision of asset condition data, attention is drawn to the requirements of the Data Protection Act 2018 [7], which might need to be taken into account when collecting (see Clause 4), processing and reporting (see Clause 7 and Clause 8) RCM data.*

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purpose of this PAS, the following terms and definitions apply.

3.1.1 additional data

data provided by RCM technologies in addition to condition categories, typically to support asset management

NOTE This varies by the technology type deployed.

3.1.2 asset management system (AMS)

process or system used by a Highway Authority to monitor and manage its assets

NOTE This includes the tools, techniques and software that support the implementation of asset management policies and objectives.

3.1.3 carriageway

main paved area of the highway carrying vehicular traffic

3.1.4 condition category

characterization of the condition of a sub-section of the road network

3.1.5 coordinate

easting, northing, and orthometric height that define the absolute geospatial location in the OSGB36 National Grid coordinate system

3.1.6 coverage

percentage of a specified length for which valid data are provided

NOTE For example, the coverage of the monitored network is the percentage of the total length of the monitored network for which valid data are provided.

3.1.7 data collection

collection of RCM data using a road condition monitoring technology

3.1.8 data collection period

period of time during which RCM data collection is being carried out

3.1.9 data fitting

alignment of the RCM data with the defined network or monitored network

NOTE Also known as “network fitting”.

3.1.10 data processing

procedures carried out on the RCM data, including data validation and data fitting

3.1.11 data validation

procedures carried out on the RCM data to check accuracy and quality

3.1.12 dual carriageway

road that has separate carriageways for traffic travelling in opposite directions

NOTE Each of the carriageways is separately referenced and designated as a dual-carriageway section.

3.1.13 forward

direction from the start point to the end point of the section

3.1.14 Highway Authority

body responsible for the management of the highway network on which RCM data are being collected

NOTE This is usually the Local Highway Authority.

3.1.15 location

process of recording the position of data on the road network both geospatially and with reference to section label and distance from a specific point

NOTE For example, the specific point chosen might be the start of a section of the road network.

3.1.16 monitored network

sub-set of the defined network (the network definition) which defines the extent (the sections) of the network over which RCM data are collected

NOTE 1 Also known as a “monitored network definition”.

NOTE 2 Requirements for scope and content of the monitored network for national reporting are provided in Clause 8.

3.1.17 network

road network used for the purpose of demonstrating the capability of RCM technologies to measure condition categories

3.1.18 network definition

spatially located and uniquely labelled set of all sections on the network

NOTE 1 Also known as a “defined network”.

NOTE 2 Data for which the network definition is acting as a key includes inventory and condition.

NOTE 3 Requirements for scope and content of the network definition are provided in Clause 4.

3.1.19 reverse

direction from the end point to the start point of the section

3.1.20 road condition monitoring (RCM)

process of collecting, processing and using data which describe the condition of roads

3.1.21 RCM data

condition categories, supporting data (such as location) and additional data provided by the RCM technology

NOTE This PAS focuses on national reporting of condition categories, but most Highway Authorities require additional RCM data beyond condition categories. Further guidance on additional data is given in Annex B.

3.1.22 RCM data collector

party undertaking the collection of RCM data

NOTE RCM data collection is typically undertaken for a Local Highway Authority by a contractor, but can be undertaken by the Local Highway Authority itself.

3.1.23 RCM data processor

party who undertakes processing of RCM data

NOTE 1 RCM data processing is typically undertaken for the Highway Authority by a contractor, but can be undertaken by the Highway Authority itself. The RCM data processor can be the same party as the RCM data collector.

NOTE 2 RCM data processing includes validation and fitting.

3.1.24 RCM provider

provider of the RCM technology, the RCM data collector or the RCM data processor (as appropriate)

3.1.25 RCM technology

methodology, tool and/or persons capable of undertaking RCM data collection and reporting condition categories

3.1.26 RCM technology type

allocation of a particular RCM technology to a specific type, defined through a set of common methods that are typically deployed by that type of road condition monitoring technology

3.1.27 road classification

nationally defined classification of a section of road in the range of M, A, B, C and U (unclassified)

3.1.28 section

fixed length of the network between fixed start and end points that are defined in accordance with referencing rules within the network definition

NOTE Also referred to as “link” in some network definitions.

3.1.29 section label

alphanumeric label that uniquely identifies a section of a road network

3.1.30 single carriageway

road that does not have separate carriageways for traffic travelling in each direction

NOTE Single-carriageway sections are either single one-way or single two-way, depending on whether they are intended to carry traffic in one or both directions.

3.1.31 sub-section

specific portion of a section of a road network

NOTE For national reporting, a sub-section is 10 m in length.

3.1.32 valid data

RCM data that have undergone both validation and fitting

3.2 Abbreviated terms

For the purposes of this PAS, the following abbreviated terms apply.

AMS	asset management system
GIS	geographic information system
GNSS	global navigation satellite system
OSGR	Ordnance Survey grid reference
RCM	road condition monitoring
UKPMS	United Kingdom Pavement Management System

4 RCM data collection

COMMENTARY ON CLAUSE 4

Highway Authorities can collect RCM condition category data for both local use and for national reporting. This clause specifies the general requirements for Highway Authorities, RCM data collectors and RCM data processors when planning and undertaking a data collection programme, and when processing RCM condition category and additional data, regardless of the intended application of the data (i.e. for local application or national reporting).

Within this clause, the roles of the Highway Authority, RCM data collector and RCM data processor are specified separately. For example, the Highway Authority might be the RCM data collector and a separate party might be the RCM data processor. However, these roles can be undertaken by the same parties for some types of RCM technology.

Requirements for the collection and reporting of RCM data for national reporting (in addition to those specified in this clause) are provided in Clause 8.

4.1 Road network definitions

4.1.1 The network definition

The Highway Authority shall establish a network definition for sections present on the road network. This network definition shall describe all sections (carriageways) that are classified as M, A, B, C or U (unclassified) roads.

The network definition shall define for each section, as a minimum:

- a) a unique identifier for the section;
- b) the road name, where present (e.g. "Station Road"), and the classified road number, where present (e.g. "A3");
- c) the geographic location (grid coordinates) of the start point of the section;
- d) the geographic location (grid coordinates) of the end point of the section;
- e) the section length in m (to two decimal places where available);
- f) the section classification (e.g. M, A, B, C or U);
- g) the section type [e.g. dual, single (one way or two way), roundabout];
- h) the section function (e.g. main carriageway, slip road, roundabout); and
- i) the number of permanent lanes in the section (e.g. 1, 2, 3).

NOTE 1 *Further information might include the number of additional lanes (e.g. hard shoulders, dedicated bus lanes, acceleration lanes, parking bays, laybys) in the section (e.g. 1, 2, 3), the speed limit, and the environment (urban/rural).*

NOTE 2 *Each carriageway is defined using a separate section. For example, for single-carriageway one-way roads and dual-carriageway one-way roads, each carriageway is defined by a single section. For two-way roads, both directions are defined by a single section. Opposite sides of dual carriageways are defined as separate sections.*

NOTE 3 *Sections should run contiguously to minimize the complexity of data collection and reduce errors in processing. Within a section, there should be no change of classification or change in the number of lanes or additional lanes.*

NOTE 4 It is advised that, where practicable, sections are no shorter than 30 m in length.

NOTE 5 This PAS does not include RCM data for off-carriageway locations (paved footways, cycleways that are segregated from the driven lane, lay-bys, bus stops, shared access areas, etc.). Therefore, the network definition should not include these lengths. However, see NOTE 3 to 4.5 regarding on-carriageway cycle lanes.

NOTE 6 The network definition, and associated rules for defining and referencing sections, are determined by the Highway Authority. However, attention is drawn to the referencing systems defined by the UK Pavement Management System (UKPMS) [8] and the Ordnance Survey MasterMap [9], which provide examples for the establishment of network definitions.

4.1.2 The monitored network definition

The Highway Authority shall establish a definition for the monitored network.

The monitored network shall be a sub-set of the network defined within the network definition.

The definition for the monitored network shall specify the sections within the network definition from which RCM data are to be provided.

The Highway Authority shall also provide further information (e.g. to assist in planning data collection and reporting the data) on the data that are required from these sections.

The definition for the monitored network shall provide, as a minimum:

- a) the identifiers of the sections within the network definition for which RCM data are to be collected;
- b) the number of lanes within each section for which RCM data are to be collected [e.g. lane 1 for a two- (or more) lane dual-carriageway section, or lane 1 and lane 2 for a two- (or more) lane dual-carriageway section, or lane 1 for a two-way single-carriageway section]; and
- c) the direction within each section for which RCM data are to be collected: forward, reverse or both.

NOTE 1 For example, for a dual-carriageway section collection “forward” is the direction from the section start point to the section end point. For a two-way single-carriageway section for which data are to be collected in both directions, this is “both”. If data are to be collected in one direction, and the direction in which this data are to be collected is from the end point to the start point, it is “reverse”.

NOTE 2 The requirements for the monitored network for national reporting are provided in Clause 8.

4.2 Highway Authority responsibilities

COMMENTARY ON 4.2

The Highway Authority may undertake the collection of RCM data on the monitored network using any type of RCM technology (see Clause 7). The Highway Authority may use different RCM technologies for different sections on the monitored network. The same type of RCM technology does not have to be deployed to collect data on all classifications of road.

To obtain RCM data, the Highway Authority shall:

- a) agree with the RCM data collector the format in which the network definition and the monitored network definition are to be provided;
- b) provide the RCM data collector with the network definition and the monitored network definition;
- c) specify the lengths over which sub-section condition category data are to be reported on the monitored network;

NOTE 1 The sub-section length for national reporting is 10 m.

- d) specify any requirement for demonstration of capability of the RCM technology in the reporting of condition categories, for each RCM technology that is to be deployed;

NOTE 2 *Demonstration of RCM technology capability is required for RCM data that are to be used for national reporting (see Clause 8). Although demonstration of RCM technology capability is not required for RCM data that are only to be applied locally by the Highway Authority, it is still good practice to provide this, to provide confidence in the data. The requirements for demonstration are provided in Clause 9.*

- e) specify the requirements for fitting of the RCM data (see Clause 7);
- f) specify and agree the format of the RCM condition category data (see Clause 7);
- g) specify any additional data that are to be provided; the format in which this additional data are to be provided; and from which sections on the monitored network this additional data are to be provided (if the data are not to be provided over the whole of the monitored network);

NOTE 3 *Additional data can be applied to support further and/or wider use of RCM data in highway asset management. Highway Authorities should take into account the range of additional data that can be provided by RCM technologies when specifying their data collection requirements. Further guidance on additional data is given in Annex B.*

- h) specify the data collection period, if appropriate (see 4.6); and
- i) specify any further practical requirements or constraints on the data collection.

4.3 RCM data collector responsibilities

The RCM data collector shall:

- a) provide a method statement for the data collection activity which describes:
 - 1) the RCM technology type(s) to be deployed;
 - 2) the agreed data collection period;
 - 3) the approach to collecting data on each lane/section of the monitored network, including quality assurance (see 9.6); and
 - 4) health and safety and traffic management plans, including risk assessments;
- b) if required, provide evidence of demonstration of the capability of the RCM technology to measure condition categories; and

NOTE *Demonstration is required for data that are to be collected for national reporting (see Clause 9).*

- c) undertake collection of RCM data on the monitored network, including the required quality assurance (see 9.6).

In cases where the Highway Authority is the RCM data collector, the Highway Authority shall fulfil the responsibilities listed in 4.3a) to 4.3c).