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Information technology — Automatic identification and data capture technology — AIDC application in industrial construction

Technologies de l'information — Technologie d'identification automatique et de capture de données — Application de l'AIDC pour la construction industrielle

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

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Introduction

Construction has a history that spans the entire human civilization. Traditional construction has lagged behind due to the interrelated issues of the rising costs, lengthy duration, massive pollution and the shortage of skilled construction labour. Industrial construction is a rapidly growing sector of construction, has the potential to be an effective solution for addressing these issues. See Annex A for more details. In the industrial construction business, mega structures including power plants, skyscrapers, warehouses, factories and other larger-than-life projects are designed, manufactured, installed and maintained by the industrialized methods. The methods include standardized design, factory production, assembly-style construction, integrated decoration and digital management. Industrial construction is an off-site, manufacturing-style construction method and system which covers all aspects of making a building, including

a) the process of making construction items such as prefabricated components, building parts, connectors or accessories from raw materials in plants,

b) the assembly, storage and shipment to the building site,

c) the assembly to specifications and building inspections,

d) maintenance,

e) potential demolition,

f) material recovery, and

g) disposal.

Automatic identification and data capture (AIDC) technology is the main technology for item and asset automatic identification and data capture since 1970s. In the past 50 years, AIDC and its global standardization have stimulated the digital transformation and informational management in the retail, healthcare and logistic industries globally.

The systematic study of AIDC technology application standards for industrialized construction will help to cope with industry challenges and promote the digital transformation and upgrading of the industry.

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Information technology — Automatic identification and data capture technology — AIDC application in industrial construction

1 Scope

This document specifies the identification, data, information services, application guidance aspects and applicable requirements of automatic identification and data capture (AIDC) technology for different items and their hierarchy in industrial construction during their whole life cycle.

This document

— provides unique identification for items in industrial construction,

— specifies the semantics and data syntax to be used,

— specifies the data carriers to be used on items of various categories, substitutes and sizes,

— makes recommendations about the metadata of the items,

— specifies the application test method and parameters based on the large-scale test and scientific sampling rules,

— defines the information services protocol to be used as an interface between business applications and the AIDC system, and

— makes guidance for designers, workers, engineers, managers, end users and maintainers about the AIDC application in their daily work.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 6707-2, *Buildings and civil engineering works — Vocabulary — Part 2: Contract and communication terms*

ISO 6707-3, *Buildings and civil engineering works — Vocabulary — Part 3: Sustainability terms*

ISO 6707-4, *Buildings and civil engineering works — Vocabulary — Part 4: Facility management terms*

ISO/IEC 15418, *Information technology — Automatic identification and data capture techniques — GS1 Application Identifiers and ASC MH10 Data Identifiers and maintenance*

ISO/IEC 15434, *Information technology — Automatic identification and data capture techniques — Syntax for high-capacity ADC media*

ISO/IEC 15459-1, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 1: Individual transport units*

ISO/IEC 15459-2, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 2: Registration procedures*

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ISO/IEC 15459-3, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 3: Common rules*

ISO/IEC 15459-4, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 4: Individual products and product packages*

ISO/IEC 15459-5, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 5: Individual returnable transport items (RTIs)*

ISO/IEC 15459-6, *Information technology — Automatic identification and data capture techniques — Unique identification — Part 6: Groupings*

ISO/IEC 15961-1, *Information technology — Data protocol for radio frequency identification (RFID) for item management — Part 1: Application interface*

ISO/IEC 15961-3, *Information technology — Data protocol for radio frequency identification (RFID) for item management — Part 3: RFID data constructs*

ISO/IEC 15961-4, *Information technology — Radio frequency identification (RFID) for item management: Data protocol — Part 4: Application interface commands for battery assist and sensor functionality*

ISO/IEC 15962:2022, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

ISO/IEC 15963-1, *Information technology — Radio frequency identification for item management — Part 1: Unique identification for RF tags numbering systems*

ISO/IEC 16022, *Information technology — Automatic identification and data capture techniques — Data Matrix bar code symbology specification*

ISO/IEC 18000-3:2010, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*

ISO/IEC 18000-63, *Information technology — Radio frequency identification for item management — Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C*

ISO/IEC 18004, *Information technology — Automatic identification and data capture techniques — QR code bar code symbology specification*

ISO/IEC 18046-1, *Information technology — Radio frequency identification device performance test methods — Part 1: Test methods for system performance*

ISO/IEC 18046-2, *Information technology — Radio frequency identification device performance test methods — Part 2: Test methods for interrogator performance*

ISO/IEC 18046-3, *Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance*

ISO/IEC 18046-4, *Information technology — Radio frequency identification device performance test methods — Part 4: Test methods for performance of RFID gates in libraries*

ISO/IEC 18046-5, *Information technology — Radio frequency identification device performance test methods — Part 5: Test methods for Environmental characteristics of RFID tag used in sporting goods*[1)]

ISO/IEC 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

ISO/IEC 19987, *Information technology — EPC Information Services (EPCIS)*

ISO/IEC 19988, *Information technology — GS1 Core Business Vocabulary (CBV)*

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1) Under preparation. Stage at the time of publication: ISO/IEC FDIS 18046-5:2024.

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ISO/IEC 20830, *Information technology — Automatic identification and data capture techniques — Han Xin Code bar code symbology specification*

ANSI MH10.8.2, *Data Identifiers*

GS1 General Specifications

GS1 EPC Tag Data Standard (TDS)

GS1 GLN Allocation Rules Standard

GS1 GTIN Allocation Rules Standard

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO 6707-2, ISO 6707-3, ISO 6707-4, ISO/IEC 19762 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
industrial construction
off-site construction method that incorporates standardized digital design, industrialized manufacturing, *assembly* (3.15) construction, integrated decoration and digital management characteristics

3.2
prefabricated component
structural *component* (3.14) and other components that constitute a building structural system, which is prefabricated in a factory or on-site

3.3
building part
unit that is prefabricated or assembled in a factory or on-site to form a single building product, a composite product of the envelope system, facility and pipeline system, and internal decoration system of a building

3.4
modular unit
integrated factory prefabricated unit, which can be transferred as a whole, such as a complete room, a part of a large room, or integrated function units (e.g. bathrooms, elevators, kitchens and machine rooms)

3.5
integrated kitchen
kitchen that is assembled from factory-produced floors, ceilings, walls, cabinets, kitchen equipment and pipelines, and that is mainly assembled by non-wet construction

3.6
integrated bathroom
bathroom that includes a floor, ceiling, wall, sanitary ware equipment and pipelines produced by the factory and that is mainly assembled by non-wet construction

3.7
connector
unit that is used to connect functional building *components* (3.14) or parts

3.8
accessory
non-structural item that is installed on buildings or structures to improve functions

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3.9
metadata
data or model that provide information about other data

3.10
master data
core information about the "who" and "what" in a business relationship

Note 1 to entry: The "who" can include the name, address and identification codes of the buyer and seller plus details of shipping, delivery and billing locations. The "what" shall include the product information such as product name, size, product model and unique identification number.

3.11
traceability
ability to trace all or part of the processes from procurement of *raw materials* (3.13) to production, consumption and disposal to clarify "when and where the product was produced by whom"

3.12
information service
set of system used for gathering, processing, storing and communicating information flow

3.13
material
raw material
substance or mixture of substances that is used to produce a product

Note 1 to entry: Materials are divided into primary materials, also known as primary raw materials, (sand, crushed stone, clay, etc.) and secondary materials, also known as secondary raw materials (concrete, building mixes, rolled metal, etc.).

3.14
component
constituent part of equipment that cannot be physically divided into smaller parts without losing its character

3.15
assembly
set of one or more sub-assemblies or *components* (3.14) constituting a single end-use product

4 Abbreviated terms

AFI application family identifier

AI application identifier

BIM building information modelling

DI data identifier

PC protocol control

HVAC heating, ventilation and air conditioning

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5 Methodology

5.1 Industrial construction and AIDC

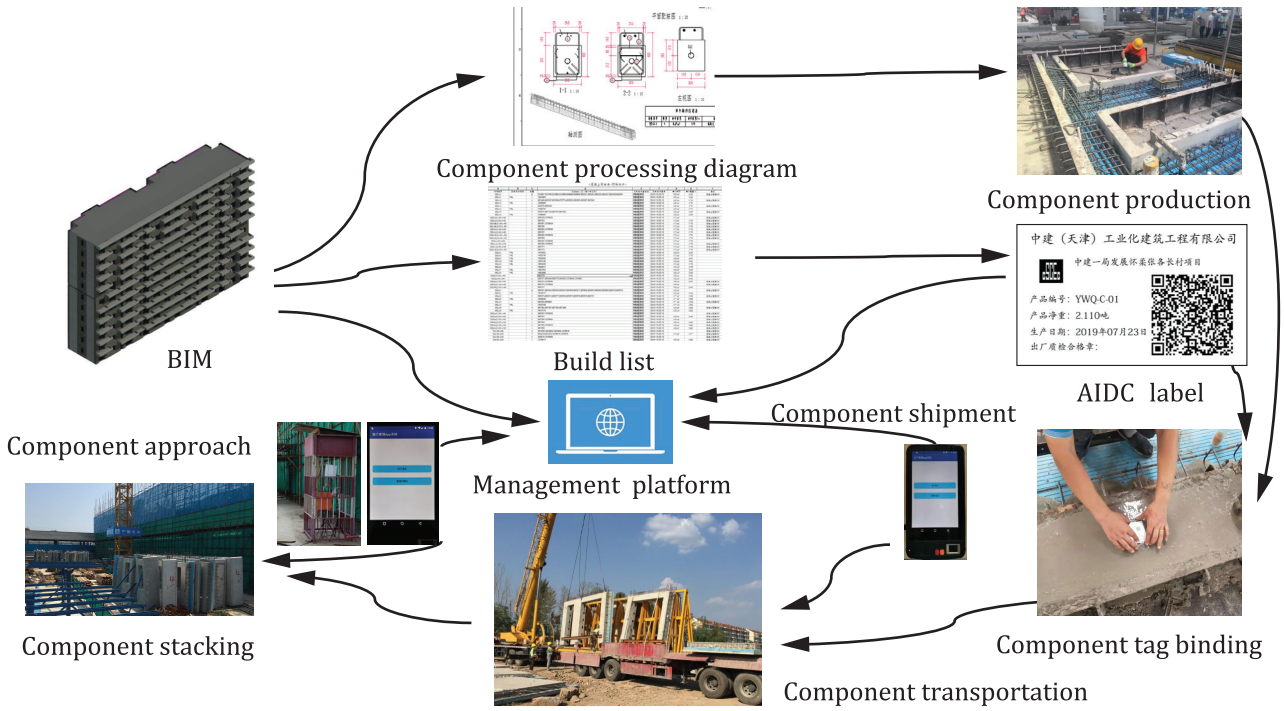

Figure 1 — AIDC and industrial construction

The evolution of industrial construction is requiring efficient supply chain management and transparency, and automatic data collecting and sharing can effectively improve its productivity. AIDC technology is one of the keys to help achieve these measures. The AIDC enhanced industrial construction process, illustrated in Figure 1, starts from planning and BIM project design stage. Right from the early stages of a building's design, architects and engineers can identify the products and parts that meet their specifications, including their environmental and operational cost attributes, and track their delivery on-site the detailed design models of the components or parts which would be the main compositions of the building would be sent to the prefabricated components plants. At the end of the production process, the items, illustrated in Annex A, are AIDC-labelled, and hence, they can be identified during the storage, transportation, assembly and maintenance, and the master data about the items and the process can be recorded. The identification tag would be utilized during the whole life cycle of the components and the construction projects.

5.2 Items in industrial construction

5.2.1 General

Since 1970s, AIDC technology is the main technology used to automatically identify and capture data for items and assets. In the past 50 years, AIDC and its global standardization have stimulated digital transformation and informational management in the retail, healthcare and logistic industries throughout the world.

As items in industrial construction are very different from items in grocery stores and hospitals, data, management approach and life cycle requirement are distinctive to the category of items.

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5.2.2 Items categories

5.2.2.1 Items without off-the-shelf identifications

This category "items without off-the-shelf identifications" includes the prefabricated components, parts, connectors, and the roofing, windows and doors, items in the HVAC and firefighting items etc. Physical items can also be classified as industrial construction items, such as building unit, apparatuses, assets or parts of the building or infrastructure. The characteristic to identify physical items is that they are the objects of information management for industrial construction and unique identification is required. For this category, the methodology and identification framework rules defined in 5.3 and Clause 6 shall apply, and the detailed identification solutions will be standardized in future documents.

5.2.2.2 Items with off-the-shelf identifications

The category "items with off-the-shelf identifications" includes items are mainly the products that already have globally accepted ISO standardised AIDC data carriers and that are uniquely identified according to ISO/IEC 15459-1, ISO/IEC 15459-4, ISO/IEC 15459-5 and ISO/IEC 15459-6. For example, the lights which already have GS1 barcodes. The identifications shall be maintained, recorded and referenced by information management systems of industrial construction during the life time of the items as the identification is agreed between business partners, and detailed information about the characteristics of the item such as brand name, net weight/content and package measurements, is available for partners. One item shall not carry more than one unique identifier. All users of GS1 identification keys and supporting data attributes shall comply with the conformance specifications and rules provided in GS1 General Specifications, which include the allocation and management rules for each GS1 identification key.

NOTE GS1 identification keys and GS1 application identifier data and GS1 data carriers are defined in GS1 General Specifications.

5.2.3 Hierarchy, relationship and life cycle

Hierarchy are the key characters for the identification and data record of components, connectors and building parts, etc. The hierarchy in this document means the composition relationships among different level of items. The hierarchy for the items in industrial construction are defined by detail-designed BIM model of different building, prefabricated components, building parts, modular units and accessories in the certain construction project. For example, a building part is made of two specific components connected by five specific connectors. See Figure 2 for a reference.

The relationship of the items in industrial construction are defined by detail-designed BIM model of different building, prefabricated components, building parts, modular units and accessories in the certain construction project. As for the components, connectors and building parts, the connection and installation order of the items are the key characters for its identification and data record.

Life cycle for the identification are mainly defined by the stakeholders of the construction which can be the contractor, subcontractor, owner, maintainer, end-users or other entities defined by regulations or orders of certain territory. The identification shall be valid during the defined life cycle.

5.3 Methodology of identification in industrial construction

5.3.1 Methodology overview

The hierarchy, relations and life cycle of entities in industrial construction is illustrated in Figure 2.

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