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BACtwin

BACtwin in public buildings

(BACtwin 2025)

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Mechanical and Electrical Engineering Working Party of National, Regional and Local Authorities

BACtwin in public buildings

(BACtwin 2025)

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For reasons of clarity and readability, this recommendation does not use pair forms. Instead, the grammatically masculine form is used in a generalized way (generic masculine). This form of designation includes both female and male persons, who are of course addressed on an equal footing.

Information about new publications can be found at http://www.amev-online.de or at the Office of the AMEV.

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List of changes

The list of changes applies to the following BACtwin description and documents only changes in the content of the document. Subordinate changes (spelling, punctuation, sentence structure, formatting, etc.) remain unmentioned here.

Within the BACtwin specification, all changes (compared to the previous version) are marked with blue color.

Version	Date	Chapter/Section	Short description of change
AMEV1.1	14.02.2025	1.2 Introduction to the BACtwin Concept	Definition BACtwin added; "Cases" replaces "special cases"; in Figure 1 BACtwin-BAS: "key" replaces “system"
		2.1.1 Trade	Reference to room automation
		2.1.5 Aggregate	"BACtwin" replaces "BACtwin UAK"
		2.1.10 User-specific Location UAK	Figure inserted: BACtwin UAK with local UAK as shell model
		2.1.15 Translation of existing UAK	Added reference to AI-based BACtwin converter
		2.1.16 Customize BACtwin UAK (with example)	Clarification: UAK example with partial plants
		2.3 Object template	Added "Adjust parameters"
		2.8 Object type Structured View (SV)	Text added
		4.2 Character set and minimum number of characters	Status_Text: Number of characters applies per state
		4.4.1 Notification class	Priority Property: States corrected
		4.9 BACtwin-capable gateway, field device and compact system	Requirements specified
		4.10 BACtwin-capable integral building automation	Reference to addressing key and BA specification sheet added
		5 Thanks for cooperation	Entries inserted and updated
		6 Thanks for contributions	Entries inserted and updated
AMEV1	12.04.2024		

Analogous to the list of changes of the BACtwin specification, each BACtwin library (XLSX file) also contains a worksheet with a list of changes, which lists the modified worksheets.

In a modified worksheet, each change (compared to the previous version) is marked with blue color at the changed location and additionally in column A.

A template with a new or significantly changed scope of the subordinate elements receives an updated version number (e.g. AMEV1.x) and a new UUID.

Foreword

Despite the progress made in building automation, the practical use of BA systems must be further improved (see [Waide: Energy CO2 saving through building automation], [Fütterer, Schild, Müller: BA in der Praxis]). The German [Building Energy Act] of 16.10.2023 makes building automation mandatory for many non-residential buildings and places specific requirements on energy efficiency, company and manufacturer neutrality. BA systems must be adapted to climate change, but also to the increasing shortage of skilled personnel.

The necessary improvements can be realized more easily with IT-based BA concepts. As people are unable to master the complex BA mass data manually, the greatest possible standardization of BA processes is expedient.

The BACtwin concept consistently implements these objectives. The abbreviation BACtwin stands for "Digital Twin in Building Automation with BACnet" and is based on the Digital Twin in the context of Industry 4.0 and BIM in the construction industry. The central BACtwin objectives are IT-supported standardization, digitalization and automation of BACnet projects.

The AMEV BACtwin recommendation is based on [AMEV BACnet 2017] and new concepts and experiences in the D-A-CH area (e.g. Austrian Armed Forces, University of Basel, Deutsche Bahn). The AMEV AK BACtwin has combined these impulses into a comprehensive, coherent data management system.

The BACtwin data model is designed as a modular system, which is based on a machine-interpretable UAK (user addressing key analogous to [VDI 3814 Sheet 4.1]. Predefined object and aggregate templates simplify the BACnet application for standard functions, but also facilitate complex BACnet applications. The data model supports data exchange without media discontinuity and enables automated 1:1 check.

The data model significantly increases the performance of planning, engineering and testing tools. BACtwin users can configure common standard aggregates easily and quickly. Thanks to the standardizations, sustainable, economical building operation can be largely automated and, with the help of technical monitoring (TMon), optimized in a more targeted manner and continuously maintained.

The BACtwin data model creates the basis for neutral and sustainable use of the BACnet protocol, for the implementation of the requirements in the German [Building Energy Act] (see §71a Building Automation) and for the integration of building automation in BIM projects.

At the heart of the BACtwin recommendation is the BACtwin library, whose templates and tables define the BACtwin data model (XLSX). This BACtwin description (PDF) contains additional explanations. The AMEV makes the library and description available for download free of charge on its homepage (Open Source approach).

The recommendation was the result of cooperation between experienced BACnet, BA and IT experts in the D-A-CH region, especially BA planners and BA operators, BACnet and BA manufacturers as well as software and tool manufacturers. We would like to thank all those who have supported the BACtwin concept through their cooperation or contributions.

The BACnet Interest Group Europe (BIG-EU) was informed about the AMEV recommendation BACtwin prior to publication.

Robert Schmidt
AMEV chair

Jürgen Hardkop
Chair of the AMEV BACtwin

1 Introduction

1.1 BACnet applications without BACtwin concept

The BACnet protocol for BA is standardized as [DIN EN ISO 16484-5] and recognized worldwide. BACnet offers an unparalleled scope of information and can be used universally for BA projects and almost all trades. The wealth of information on offer often poses problems for builders and planners. Despite intensified further training, BACnet specialists are still a small minority. Despite this, BACnet occupies a leading position in building automation and is the norm in public buildings. Different methods of using BACnet have developed.

The advantages of manufacturer-specific BACnet applications were initially used by many builders. In the initial phase, this was an understandable strategy for dealing with the new communication protocol. However, BACnet operators have to accept extensive dependence on the respective BACnet company, e.g. unexpected changes to products or company strategies. This constellation is also problematic in terms of public procurement law and is not a permanent solution.

The first recommendation for manufacturer-neutral BACnet applications in public buildings was published in "AMEV BACnet 2007". The central element was the specification of AMEV profiles for AS (Automation station) and MOU (Management and operating unit). The AMEV profile (e.g. AS-B) have proven themselves and are recognized in the D-A-CH area. From 2011, the AMEV simplified the testing procedure and issued AMEV test certificates for the AMEV profiles AS-A and AS-B together with WSPCert.

Incomplete usage specifications continue to cause problems. The central obstacle is the complexity caused by countless BACnet properties, the relevance of which is not always transparent for builders, planning and operation. The BACnet standard does not contain any rules for the implementation of specific tasks (e.g. in control systems or regulations) in objects. As there is no standardized data structure for project data, data exchange without media disruptions is not possible. Acceptance tests are only carried out manually and on a random basis. The groundbreaking inventory of the ÖBH [Kranz, Fritzenwallner: Digitaler Zwilling] also shows that the interpretations of the standard by the BA manufacturers differ significantly.

In vendor-neutral BACnet projects with several BA companies (multi-vendor projects), a profile-based BACnet concept alone is not sufficient to ensure the desired user-oriented and optimized operation.

1.2 Introduction to the BACtwin Concept

The problems described above usually occur when IT-supported processes and applications have grown historically. Typical consequences of such developments include data islands, interface problems, media disruptions and inconsistent data usage.

The core problem is the lack of an overall digital concept, which can be solved by the digital twin. The digital twin is a comprehensive data model that represents real processes (e.g. BA systems) or objects and consists of models and data of the processes or objects.

Thanks to the standardization of the BACnet protocol, the advantages of the digital twin can also be used for BACnet-based BA systems. The digital data model for BACnet-based BA systems is referred to as BACtwin (short for: digital twin in building automation with BACnet). This abbreviation is intended to avoid confusion with other digital twins (e.g. Industry 4.0) and with conventional BACnet systems (without a digital twin).

BACtwin is a data model that describes basic BA functions as well as standard aggregates, assemblies and systems on the basis of the BACnet protocol (DIN EN ISO 16484-5) in a manufacturer-neutral manner and makes them available as an open interface.

The BACtwin concept consists of the BACtwin library, which defines the digital data model (see Figure 1, yellow, orange) and the BACtwin specification, which explains the BACtwin library and provides instructions for BACtwin implementations.

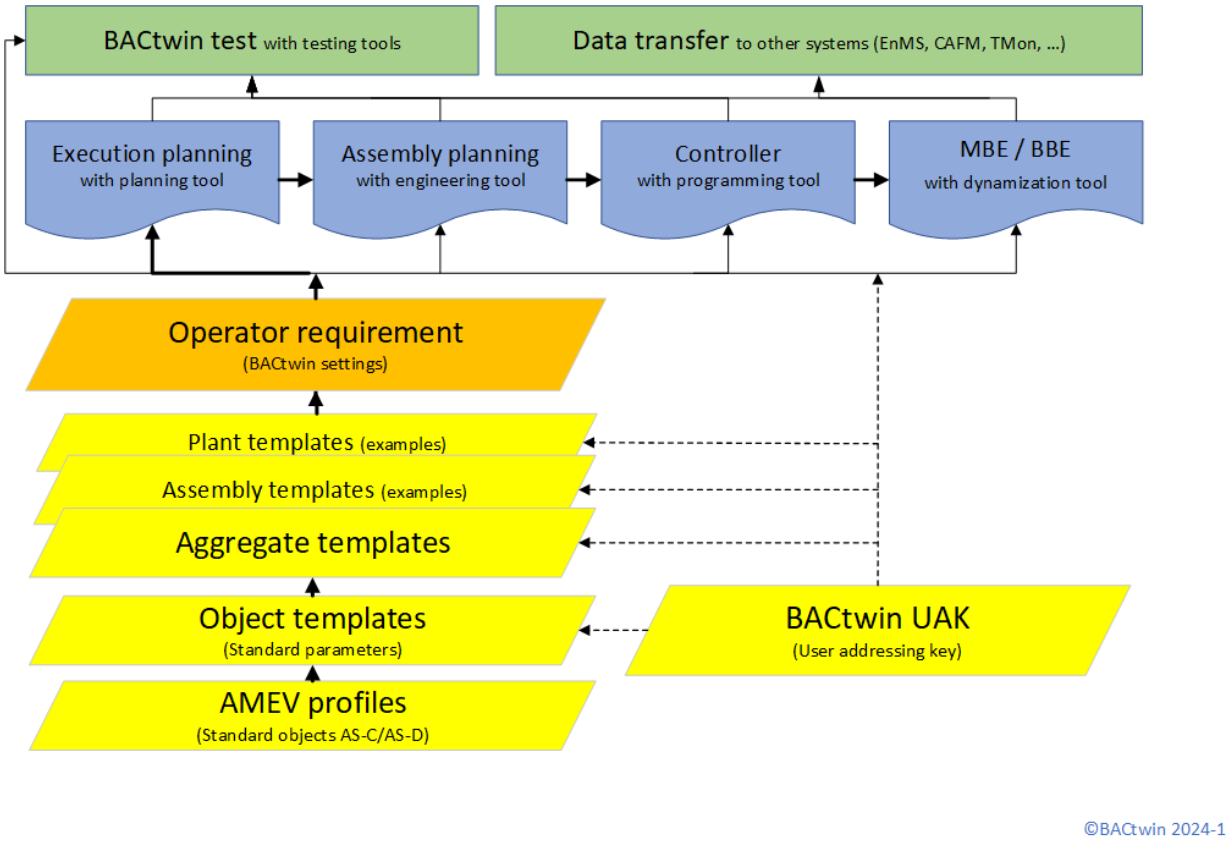


Figure 1 BACtwin library (yellow, orange) und BACtwin-capable SW tools (blue, green)

The BACtwin data model is designed to be machine-interpretable, user-friendly and future-proof. It captures all project data relevant for planning, engineering and operation, but avoids redundancies. Relevant objects and processes are mapped consistently over the entire life cycle, i.e. starting with planning, during construction and operation through to recycling or disposal.

The machine-readable and interpretable user address key (UAK) plays a key role in the data model. The BACtwin UAK offers logical structures, practice-oriented, accurate terms and a comprehensive, cross-trade data scope.

The worksheets of the BACtwin library are called templates (e.g. object templates) or tables. Important tables (i.e. with inheritance of IT properties) are referred to as templates.

More than 300 object templates have been standardized on the basis of the BACtwin UAK and the updated AMEV profiles. These object templates are used to configure more than 100 aggregate templates for standard aggregates (e.g. single-stage pump) according to the modular principle. Approximately 50 templates for standard assemblies are defined on the basis of the aggregate templates (e.g. reheater). The plant templates are created as examples for several standard plants (e.g. weather station).

In addition, check tables display selected data content in a direct context so that users can more easily overview and check the data consistency in this context (e.g. all UAK abbreviations sorted alphabetically, overview of the Priority_Array).

To ensure that the BACnet terms are unambiguous, the standard terms are used in tables and templates. Due to machine interpretability, the standard terms must not be changed (e.g.

abbreviated). In the BACtwin description, special standard terms are supplemented by German terms (in brackets) to make them easier to understand.

BACtwin-capable software tools (SW tools) are required for project management, which support IT-supported, consistent processing of BACnet project data and simplify the planning and construction of efficient BA systems. To this end, software and BACnet manufacturers integrate the BACtwin library as a reference model for BACtwin implementation in their planning, engineering and testing tools.

Users do not fill out the XLSX tables, but use BACtwin-capable SW tools. The planning tools and engineering tools (shown in blue in Figure 1) are used to configure the project-specific aggregates, assemblies and plants required. If required, the predefined standard aggregates can be modified for specific projects as so-called project aggregates.

The developed BA project data is bundled in the project library. The structures and designations of the project data are based on the structures and terms of the BACtwin library. Due to the different contents, the lists of project data (= IT-supported work results) are referred to as lists (e.g. aggregate lists).

Table 1 compares the names of the templates/tables of the BACtwin library with the names of the lists of BACtwin project data.

BACtwin library (templates, tables)	**BACtwin project data** (lists)
Object templates	Object lists
Aggregate templates	Aggregate lists
Assembly templates	Assembly lists
Plant templates	Plant lists
BACS function table	BACS function lists
BACtwin table	BACtwin lists
BACtwin library	Project library

Table 1 Synopsis BACtwin library – BACtwin project data

In the BACtwin data model, the responsibilities for the project data are clearly defined. The client or operation, BA planning and BA execution have different tasks to fulfill. Depending on the project phase and responsibility, the project library is filled with the required entries.

BACtwin-capable checking tools (shown in green in Figure 1) are used for automated checking of the extensive data in a project library. The checking tools enable 1:1 checks of the relevant BA project data, detect deviations, gaps etc. and document necessary corrections. To do this, they compare the BA planning with the operator requirement (orange in Figure 1) and the execution with the planning.

In the operator requirement (see table 28), the client/operator specifies the application of the BACtwin concept in his organizational area (e.g. the location-specific addressing and his user-specific selection of the available BACtwin variants).

Standardized data formats and interfaces are used in all project phases to ensure IT-supported data exchange without media disruptions and loss of information.

The BACtwin library comprises three parts (XLSX files):

- **Library 1:** BACtwin UAK
- **Library 2:** AMEV profiles, object templates
- **Library 3:** Aggregate templates

The libraries are interlinked (see figure 1) and together form the data model of the BACtwin concept.

Each library represents the associated tables on the first worksheet "Directory".

Note: *The English translations of texts, templates and tables are limited to raw translations of the plain texts. Suggestions for translating the BACtwin abbreviations and terms are listed in Library 1 in Worksheet 4.2 BAS de-en. Complete English translations are only useful once the suggested translations e.g. of abbreviations have been revised and accepted by native English speakers (suggestions are welcome).*

The following principles were taken into account when defining the BACtwin data model:

Goal 1 Standardization as far as possible

Public buildings often have several thousand BA data points and an even higher number of properties and parameters (BACtwin: appr. 20 parameters/object). The verifiability and manageability of this mass BA data is of central importance in BA projects and system operation.

The data model is not aimed at the largest possible number of implemented BA functions, but at the sensible selection and uniform specification of the basic BA functions. The focus on essentials has proven itself in the AMEV profiles and should also be taken into account when using the data model in BACtwin projects.

Clients and operators should only allow individual changes to the standard templates or reductions in the standard functions in justified cases. The advantages of changes must clearly outweigh the disadvantages - even in the long term.

Rarely used or "exotic" aggregates that have to be checked manually should be avoided. The omission of standard functions, e.g. to reduce investment costs, is also critical. BA mass data should not be planner- or manufacturer-specific, but should be neutrally standardized and automatically testable.

Goal 2 End-to-end digitalization

The BACtwin data model is universally applicable for the BA systems of municipalities, federal states, the federal government, universities, hospitals and other builders and operators. The data model is standardized in a manufacturer-neutral way.

The BACtwin data model is based on the state of the art. A BACnet-based, machine-interpretable standard is defined for each common BA function. This is the minimum requirement, but can be used differently in justified exceptional cases. It can be extended for innovative solutions.

In BACnet systems, the object information (properties) is implemented in automation station.

The data model contains all input/output functions that are necessary for efficient operation. The data model contains all messages required for operational monitoring. It also includes messages that lead to uncontrolled energy consumption in the event of malfunctions or incorrect operation (e.g. manual positions)

The data model contains all data recordings with which energy malfunctions can be subsequently determined and evaluated. The data series can be historized in a database and serve as a basis for technical monitoring during commissioning and operation.

The standard-compliant BA project data can be checked automatically using test tools. The greatest possible standardization, digitalization and automation significantly improves the efficiency of BA projects, BA operations and the FM processes based on them.

Goal 3 Future-proofing

The data model is designed as an expandable modular system. It is adapted to further developments in technology (e.g. new revisions, technologies, TMon experiences, BIM projects, sustainability reports). The data model is kept permanently consistent through versioning.

Future extensions can be planned and built using the latest version of the BACtwin model.

The data model is described in the following chapter. For a better understanding, the templates and tables explained are shown, but only as excerpts. The BACtwin libraries contain all templates and tables with all the details.

2 The BACtwin data model

2.1 BACtwin UAK

The complex mass data in BA systems can only be managed efficiently with the help of powerful IT tools. However, the basic prerequisite for the use of IT tools is that machine-interpretable addressing, designations, abbreviations and data content are used in the BA systems in accordance with standardized specifications of the builders or operators.

The key element of the BACtwin concept is a machine-readable and interpretable user addressing key. Thanks to the BACtwin UAK, BACtwin-capable IT tools can clearly identify the addressed elements (e.g. aggregates, functions) and interpret, for example, their arrangement and function in the overall system.

In BACtwin systems, the user addresses are defined in the Object_Name property of the BACnet objects as a unique ID using abbreviations. The user address is based on a UAK, which is made up of the location UAK with location-related UAK blocks and the BACtwin UAK with function-related UAK blocks (= function UAK).

In existing buildings and systems, UAK are used according to the individual specifications of the builders or operators. They can continue to be used in existing buildings, but are generally not suitable for low-effort 1:1 evaluations with testing tools such as TMon software.

In order to utilize the advantages of the BACtwin concept, BA systems must have a machine-interpretable UAK that supports automated evaluations in combination with other IT systems (TMon, BIM, CAFM, etc.).

For this purpose, the AMEV working group BACtwin has developed the machine-interpretable BACtwin UAK on the basis of [VDI 3814 Sheet 4.1]. The BACtwin UAK should be integrated into the new construction, renovation or expansion of BA systems - if necessary in addition to an existing UAK concept. The BACtwin UAK supports automated evaluations even in very complex BA systems. In contrast to older existing UAKs, it also addresses the BACnet object types of the AMEV profiles.

Table 2 contains an exemplary structure of the BACtwin UAK with the function-related BACtwin UAK blocks.

UAK block	Designation	Explanation	Character	Example
1.	Trade	Cost group (DIN 276-1)	1-3	420
2.	Plant	Abbreviation with number	5-9	CON01
3.	Assembly	Abbreviation with number	11-15	SHS01
4.	Medium, Position	Abbreviation	17-19	HTF
5.	Aggregate	Abbreviation with number	21-25	#####
6.	Operating Equipment (OE)	Abbreviation with number	27-31	T~~01
7	OE Function	Abbreviation with number (without extension)	33-37	MS~01
8. (opt.)	OE Function Extension	Abbreviation for extension (e.g. TL, EE), otherwise free	38-40	_TL

Table 2 Structure of BACtwin UAK (example)

For the BACtwin UAK in Table 2 (420_CON01_SHS01_HTF_#####_T~~01_MS~TL01), 40 characters are required (with separator).

BACnet-capable products must support at least 64 characters for the "Object_Name" property in accordance with ([DIN EN ISO 16484-5] Tab. K4). This means that up to 23 characters are available for the location UAK.

User-specific adjustments (see 4.11) can change the number of characters in the BACtwin UAK and in the location UAK.

The BACtwin UAK has a machine-interpretable structure with uniform UAK lengths.

The UAK blocks are separated by an underscore "_". A degree sign "°" is used as a separator within a UAK block. Partial plants can be inserted in the UAK block Plant using degree characters or the floor number can be separated from the room number when addressing room automation.

Abbreviations have three digits. A missing letter is filled in with a tilde "~" (e.g. MS~01). A missing UAK block (e.g. assembly group in sanitary facilities) is filled in with hash marks "#####". The underscore, tilde and hash characters belong to the UTF-8 character set.

A non-proportional font with the same letter widths is recommended for tables; see the following example of the Consolas font for tables.
Example of Consolas font: `420_VBA01_STH01_HZV_#####_T~~01_MS~TL01`

In UAK, an abbreviation and the corresponding designation each form a unique character.

The UAK blocks are divided horizontally according to trades. Each UAK block contains a selection of common elements for each trade. In the case of frequently used elements, there may be multiple mentions across trades (e.g. VLV = valve, PMP = pump). If terms and abbreviations required in a trade are missing, the appropriate terms and abbreviations can be taken from other trades.

As room automation (originally VDI 3813) will in future be described together with system automation in VDI 3814, the elements of room automation have been classified in trade 480. This amalgamation is also reflected in DIN 276.

The UAK blocks and other aspects of BACtwin UAK are explained below.

2.1.1 Trade

A trade comprises construction services that are provided and maintained by specialized experts. The structures of the trades are based on the cost groups according to DIN 276-1 and the abbreviations and designations according to VDI 3814 Sheet 4.1 (see Table 3).

No.	Cost group (DIN 276-1)	Abbreviation (VDI 3814 4.1)	Designation (VDI 3814 Blatt 4.1)
1.	330	GWS	Gates, doors, windows, sunshades
2.	400	TBS	Technical building services (general)
3.	410	SAN	Sanitary (sewage, water, gas)
4.	420	HTG	Heating
5.	430	VEN	Ventilation
6.	434	REF	Refrigeration
7.	440	ELT	Electric power
8.	450	CIT	Communication and IT
9.	460	CVR	Conveyor
10.	470	USS	Usage specific services
11.	480	BAC	Building automation and control
12.	550	TSO	Technical services in outdoor facilities

Table 3 Trade

Numerical cost groups in accordance with DIN 276-1 (e.g. 420) are recommended, as they create a link to higher-level approaches (e.g. BIM, FM).

Alternatively, alphabetical abbreviations according to VDI 3814 Sheet 4.1 and BACtwin UAK (e.g. HZG) can be selected (operator requirement in Section 4.11).

In the event of overlaps, the main aggregate is used (e.g. CHP heat-led = KG 420, CHP electricity-led = KG 440). In the case of room automation systems, the responsibilities of the building owner or operator must be clarified according to the local conditions.

2.1.2 Plant, Partial plant

A plant forms a functional unit that belongs together in the trade, which can, for example, consist of assemblies, aggregates and equipment and can perform certain functions.

Note: *The UAK must not be confused with the plant identification system (PIS) in accordance with [VDI 3814 Sheet 4.1]. The PIS does not address individual BA functions, but is limited to the higher level of the systems. The UAK addresses specific BA functions by means of user addresses. The UAK contains the PIS and the equipment.*

If, in special cases, partial plants are also to be addressed, the plant block can be extended. Two additional digits identify the complete plant (00) and the partial plants (01-99). A degree sign "°" separates the additional digits from the overall installation.

Example of partial plants

430_VTP01°**00**_FAS02_SA~_#####_#####_CS~01	Complete Plant
430_VTP01°**01**_FAS02_SA~_#####_#####_CS~01	Partial plant 01
430_VTP01°**02**_FAS02_SA~_#####_#####_CS~01	Partial plant 02

The BACtwin UAK requires a larger number of characters when addressing partial plants. This must be taken into account in the operator requirement for the local UAK.

Rooms are also addressed in the UAK block Plant (see section 2.1.12 Room automation).

2.1.3 Assembly

An assembly forms a functional unit in a plant that can consist of several aggregates and operating equipment, e.g. a heater assembly in ventilation technology or a low-voltage main distribution board in an electrical distribution system. If there is no assembly group (e.g. in sanitary systems), the empty space in the UAK block is filled with "#####".

2.1.4 Medium, Position

Aggregates and operating equipment must be addressed within plant and assemblies. Each aggregate and operating equipment is usually assigned to a medium, e.g. a physical carrier (liquid, gas, etc.) such as heating water, supply air, oxygen. In addition, an aggregate and equipment can be used at a specific position of the medium (e.g. forward (flow), return, inlet, outlet).

In the UAK block Medium, Position, a three-character abbreviation usually identifies the medium with two characters (e.g. heating water = HT) and the position with the third character (e.g. F = Forward (flow) or R = return). Examples for heaters are heating water forward (flow) (HTF) and heating water return (HTR). If the position is not required, the third position is a tilde, e.g. supply air (SA~).

The arrangement of the UAK block Medium, Position before the UAK block Aggregate ensures that the numbering always starts at 1 for the same aggregates in different media or positions.

2.1.5 Aggregate

An aggregate is a component that consists of one or more items of equipment, e.g. a fan with motor, frequency converter, repair switch and LO/ID, an individual sensor or combined sensor or a room operating unit with several operating elements and sensors.

The operating equipment associated with the aggregate is listed in the following UAK block Operating equipment (e.g. motor, FI, repair switch and LO/ID). The functions of the individual operating equipment (e.g. switching command, operating message, fault message) are specified in the following UAK block BM function.

In this BACtwin, only physical aggregates (hardware) are taken into account. There are also virtual aggregates, e.g. application functions or macros in accordance with VDI 3814 Sheet 3.1ff with the associated objects. Virtual aggregates are considered at a later point in time.

If no aggregate exists, the UAK block Aggregate is filled with "#####".

2.1.6 Operating equipment (OE)

An operating equipment is a component that fulfills one task. It can consist of hardware (tangible, e.g. motor, sensor) or virtual information (e.g. efficiency).

A component with several properties (e.g. a combined sensor) is not classified as a piece of equipment, but rather as an aggregate with several pieces of equipment.

2.1.7 OE function

The OE function specifies a signal of the operating equipment. This can be e.g. the measured value of the room temperature, for which there can also be a setpoint. With a flap there are e.g. the functions switching command, feedback OPEN and feedback CLOSED.

2.1.8 OE function extension

If an object of the type Trend Log (TL) or Event Enrollment (EE) references another data point (e.g. data recording, alarm), the referencing object receives a three-digit extension _TL or _EE, which is added after the function identifier and numbering (e.g. MS~01_TL).

References an object of type Schedule (SCH), e.g. B. a value object (AV, BV, MV), the referencing object receives the extension _SH (schedule).

Alternatively, the extension TL, EE or SH (without underscore) can be inserted between the function identifier and the numbering (e.g. MS~TL01).

The resulting difference in length is obvious and intentional. Alternatively, the original data point can be filled with “~~” if the length difference is not desired.

2.1.9 Numbering

There is no numbering for the UAK blocks Trade and Medium, Position.

Identical plants, assemblies, aggregates, Operating equipment and functions that are used in parallel are distinguished by numbering (e.g. fans 01 - n in a fan wall). The number is only increased if, in addition to the current UAK block, all preceding UAK blocks are identical.

Example numbering

430_VTP01_ERH01_SA~_SSR01_T~~01_MS~01
430_VTP01_ERH01_HTF_SSR01_T~~01_MS~01
430_VTP01_ERH01_HTR_SSR01_T~~01_MS~01

430_VTP02_ERH01_SA~_SSR01_T~~01_MS~01
430_VTP02_ERH01_HZV_SSR01_T~~01_MS~01
430_VTP02_ERH01_HTF_SSR01_T~~01_MS~01

For an assembly, the distinction should be made in the UAK block Medium, Position, for example:

HTA01_HTF_VLV01_#####_SP01 and
HTA01_HTR_VLV01_#####_SP01.

As a rule, two-digit numbers are provided. Users can set single-digit numbers for selected UAK blocks system-wide.

Three-digit numbers are possible but should be avoided due to the limited UAK length. If necessary, division into effective areas is recommended (e.g. fire dampers are separated by the medium in front of the UAK into exhaust, recirculation and supply air, each < 99).

2.1.10 User-specific Location UAK

The location-related part of the UAK depends on the conditions of the properties, buildings, components and rooms. AMEV specifications for standardized Location UAK do not make sense. It is the task of the organization (e.g. municipality, university, state administration, federal administration) to define the Location UAK across the organization clearly, uniformly and in a future-proof manner (if necessary using CAFM, digital spatial register, BIM) and to specify it in a binding manner.

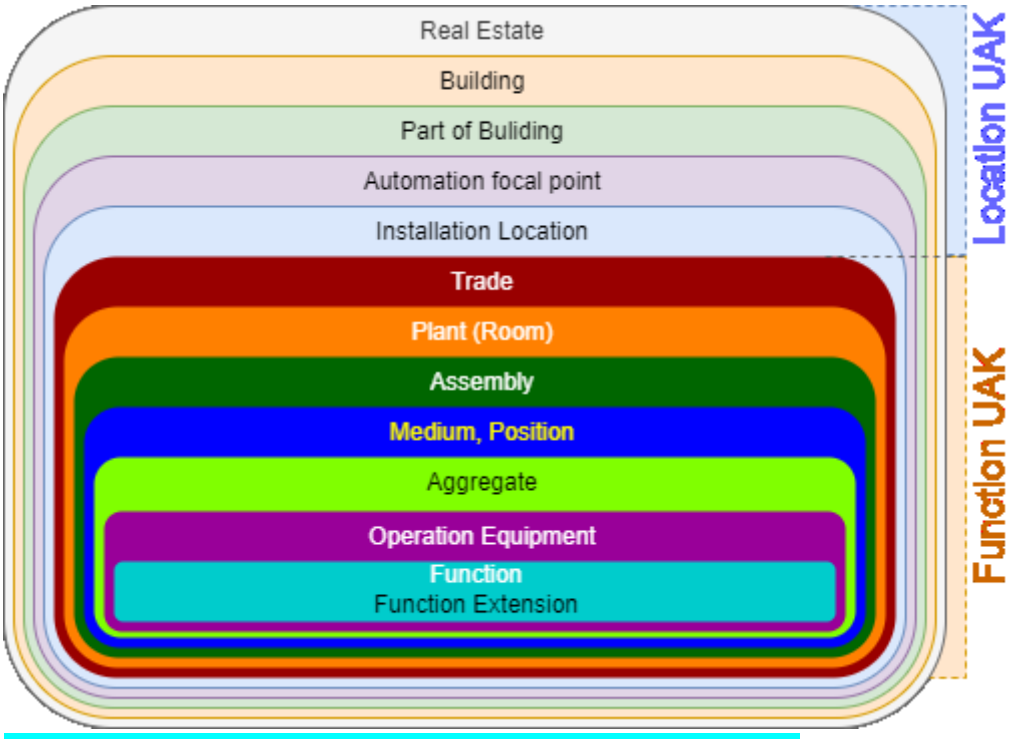


Figure 2 BACtwin UAK with Location UAK as shell model

Figure 2 shows the interaction between the BACtwin UAK (= functional UAK) and the user-specifically defined Location UAK (here an example) as a shell model.

2.1.11 User-specific Description

The property description contains plain text according to the specifications of the BACtwin libraries, specified by the client or operator.

The following Example Description is recommended as content. An Alternative Description is shown below, which begins with the signal information instead of the location information. The alternative description can be selected (section 4.11).

Example Description:
House 1 Room 5.20 (warehouse) Heater heating water flow temperature reading

Alternate Description:
Reading temperature heating water flow heater room 5.20 (warehouse) house 1

2.1.12 Room automation

In a room automation system, the aggregates from different trades in the respective room work together in an interdisciplinary manner like a plant.

The effective location of the room automation (RA) is addressed in a position-oriented manner in the UAK block system (e.g. as “plant” RAR).

The addressing of the room automation is based on the shell model (see VDI 3813 Sheet 1). The spatial structure is mapped depending on the Building, Area, Room or Segment (e.g. with RAB, RAA, RAR, RAS).

Since room numbers can change during operation and only the description can be changed by the BA operator, room numbers should preferably be integrated into the description. Additional information for BACtwin-capable room automation can be found in Section 4.10.

2.1.13 Presentation of the BACtwin UAK

Table 4 BACtwin UAK (excerpt) below, contains an overview of the UAK blocks as an excerpt; the associated abbreviations and designations are sorted by trade.

Italic text explains the respective designation.
Example: WAZ, water meter *(main meter)*.

Grayed out abbreviations are not recommended (e.g. blurred, obsolete); the abbreviations recommended as replacements are listed in brackets.
Example: FLH, surface heating (recommended: FBH, WDH, DKH).

In Table 4 the Content Description columns are hidden for better clarity.

Library 1 contains the complete BACtwin UAK. In addition to the UAK blocks, abbreviations and names, there are also the Content Description columns.

With the help of the Content Description column, the description in the aggregate templates can be created automatically by means of concatenation. On this basis, user-specific adaptation of the plain texts can be carried out efficiently.

In addition, the library 1 contains more worksheets that have been set up for the practical application of the BACtwin-BAS.

Worksheet 4.1 UAK Example presents a UAK example in tabular form (explanations follow in section 2.1.16).

Worksheet 4.2 UAK de-en lists all abbreviations and designations in alphabetical order in one column each (across UAK blocks, without multiple answers). At the same time, English translations are proposed for the abbreviations and names.

In addition, each UAK abbreviation has, among other things, a UUID (Universally Unique Identifier) that supports the import and use of the UAK abbreviation and the associated names in databases without naming conflicts.

Additional required abbreviations, names and translations can be communicated to the AMEV (see 4.11).

1. Gewerk			2. Anlage		3. Baugruppe		4. Medium/Position		5. Aggregat		6. Betriebsmittel		7. Funktion		8. Funktion-Erweiterung	
KG	Kürzel	Bezeichnung	Kürzel	Bezeichnung	Kürzel	Bezeichnung	Kürzel	Bezeichnung	Kürzel	Bezeichnung	Kürzel	Bezeichnung	Kürzel	Bezeichnung	Kürzel	Bezeichnung
1	2	3	4	5	7	8	10	11	13	14	16	17	19	20	22	23
330	TTF	Türen, Tore, Fenster	330	Türen, Tore, Fenster, Sonnenschutz	330	Türen, Tore, Fenster, Sonnenschutz	330	Türen, Tore, Fenster, Sonnenschutz	330	Türen, Tore, Fenster, Sonnenschutz	330	Türen, Tore, Fenster, Sonnenschutz		***Signal:***		
			FAA	Fassadenanlage (ohne Raumbezug)	SON	Sonnenschutz, Beschattung, Verdun	FA~	Fassade	TOR	Tor	MOT	Motor	AF~	Anforderung	EE	referenzierte Meldung
							RU~	Raum	TUR	Tür	FEG	Fenstergriff	AFH	Anforderung Heizen	TL	referenzierte Datenaufzeichnung
			RWA	Rauch- und Wärmeabzugsanlage	NRA	Natürlicher Rauchabzug			BST	Brandschutztür	FEK	Fensterkontakt	AFK	Anforderung Kühlen	ZP	referenzierter Zeitplan
							[nnn]	Ausrichtung (*in °; nnn = 000-360*)	SLS	Schleuse	G~~	Position, Länge, Amplitude	AFT	Anforderung Temperieren		
			RAG	Gebäude *(Schalenmodell)*	MFT	Multifunktionstüre	n00	Fassade Nord	DRK	Drehkreuz	GS~	Position schaltend, Endschalter	AFL	Anforderung Lüften		
			RAA	Abschnit			o00	Fassade Ost			WIN	Winkel	AFV	Anforderung Voll		
			RAB	Bereich *(Schalenmodell)*			s00	Fassade Süd	FEN	Fenster			AFR	Anforderung Reduziert		
			RAR	Raum *(Schalenmodell)*			w00	Fassade West	JAL	Jalousie			BB~	Betriebsbereit		
			RAS	Segment *(Schalenmodell)*					MAR	Markise			BEE	Befehl Extern Einspeiseleistung		
									ROL	Rollladen			BLZ	Belegungszustand *(z.B. Raum)*		
									VEG	Verdunklung, Vorhang			BM~	Betriebsmeldung		
													BSM	Betriebssammelmeldung		
									RSA	Rauchschutzabschluss *(vormals RSV)*			BZ~	Betriebsstunden Zählwert		
													FR~	Freigabe		
									RWS	Rettungswegesystem *(vormals FWS, Fluchtwegesicherungsanlage)*			FRA	Freigabe Absenkbetrieb (z.B. AT-Abschaltung HK)		
													FRK	Freigabe Komfortbetrieb (z.B. AT-Abschaltung HK)		
													MW~	Messwert		
													MWB	Messwert Bezug *(Elektro Zweirichtungszähler)*		
													MWC	Messwert berechnet		
400	TGA	Technische Anlagen	400	Technische Anlagen	400	Technische Anlagen	400	Technische Anlagen	400	Technische Anlagen	400	Technische Anlagen	MWE	Messwert Einspeisung *(Elektro Zweirichtungszähler)*		
					SLE	Leuchte *(Signalleuchte)*	400	Heizung/Kälte (Kombi-System)	PPE	Pumpe	FU~	Frequenzumrichter	MWK	Messwert Kälte *(nur bei Kombizähler)*		
					MEB	Messbox	%%V	Vorlauf			FEE	Funktional eigenständige Einrichtung	MWW	Messwert Wärme *(nur bei Kombizähler)*		
							%%R	Rücklauf	SSK	Schaltschrank	ASR	Autarke Steuer- oder Regeleinheit	RBE	Rückmeldung Befehl Extern Einspeiseleistung		
					RVT	Raumverteiler	%%Z	Zulauf			BYP	Bypass	RM~	Rückmeldung		
							%%A	Ablauf	EF~	Einzelfühler *(ein Signal)*			RMA	Rückmeldung Auf		
							%%I	Eintritt *(Input)*	MFE	Mehrfachfühler Einheit *(mehrere Sig*	REP	Reparaturschalter	RME	Rückmeldung Ein		
			VTA	Verteilanlage	TKR	Temperierkreis *(Zweileiter Heiz- / Kü*	%%X	Austritt *(Exit)*			REV	Revisionsschalter *(AT, CH)*	RMS	Rückmeldung Aus		
					TVT	Temperierverteiler *(Zweileiter Heiz-/*	%%H	Warm *(Hot)* (empfohlen z.B. %%V)	ELZ	Elektrozähler *(Hauptzähler)*			RMZ	Rückmeldung Zu		
							%%C	Kalt *(Cold)* (empfohlen z.B. %%R,	WMZ	Wärmemengenzähler *(Hauptzähler)*	PD~	Differenzdruck	RMG	Rückmeldung Erde (Ground)		
							%%U	unten	GMZ	Gasmengenzähler *(Hauptzähler)*			RVM	Revisionsmeldung *(Sicherheitschalter)*		
							%%M	mitte	BSZ	Brennstoffzähler *(Hauptzähler)*	MSH	Feuchte relativ schaltend hoch, Rege	RW~	Rückführwert		
							%%O	oben	DMZ	Dampfmengenzähler *(Hauptzähler)*			SB~	Schaltbefehl		
							%%B	Boden	KMZ	Kältemengenzähler *(Hauptzähler)*	G~~	Position, Länge, Amplitude	SBA	Schalt-,Stellbefehl Auf		
							%%W	Wand	KWZ	Kombinierter Kälte- und Wärmemeng	GS~	Position schaltend, Endschalter	SBE	Schaltbefehl Ein		
							%%D	Decke	WAZ	Wasserzähler *(Hauptzähler)*			SBM	Schaltbefehl Mehrstufig		
							%%S	Schacht	MMZ	Medienmengenzähler			SBR	Schaltbefehl Reduzierung		
							%%K	Kabine	STZ	Stückmengenzähler			SBS	Schaltbefehl Aus		
							%%L	maschinenraumlos					SBZ	Schalt-,Stellbefehl Zu		
							%%N	außen					SM~	Störmeldung		
													SN~	Seriennummer *(z.B. Zähler...)*		
							HK~	Heizung-, Kälte-					ST~	Stellsignal		
							HKV	Heizung-, Kälte-Vorlauf					STC	Stellsignal errechnet		
							HKR	Heizung-, Kälte-Rücklauf					SVM	Sollwertverstellung, mechanisch (empfohlen: SWV)		
							HKH	Heizung-, Kälte-Warm *(Hot)*					SW~	Sollwert		
							HKC	Heizung-, Kälte-Kalt *(Cold)*					SWV	Sollwertversteller		
							OL~	Öl					WBS	Wiederbereitschaftsschaltung *(z.B. Fahrtreppe)*		
							AG~	Abgas					ZTW	Zeitwert *(Periode)*		
							BE~	Beckenwasser					ZW~	Zählwert		
							RU~	Raum					ZWB	Zählwert Bezug *(Elektro Zweirichtungszähler)*		
							AU~	Außenluft					ZWE	Zählwert Einspeisung *(Elektro Zweirichtungszähler)*		
													ZWK	Zählwert Kälte *(nur bei Kombizähler)*		
													ZWW	Zählwert Wärme *(nur bei Kombizähler)*		
410	GWA	Abwasser-, Wasser-	410	Abwasser-, Wasser-, Gasanlagen	410	Abwasser-, Wasser-, Gasanlagen	410	Abwasser-, Wasser-, Gasanlagen	410	Abwasser-, Wasser-, Gasanlagen	410	Abwasser-, Wasser-, Gasanlagen		***Signal Meldung:***		
			NZA	Netzanschluss			AW~	Abwasser	PPE	Pumpe	MOT	Motor	AM~	Alarmmeldung		
							AWA	Abwasser-Ablauf	VEN	Ventil	FU~	Frequenzumrichter	ANO	Anormalmeldung		
			EZA	Erzeugungsanlage	TWE	Trinkwassererwärmungsanlage (bis	AWZ	Abwasser-Zulauf	KLA	Klappe	EC~	Elektronisch drehzahlgeregelt	BZG	Betriebsstunden Grenzwert (empfohlen: High-,Low_limit verwenden)		
					PFS	Pufferspeicher							GM~	Gefahrmeldung		
					KBS	Kombispeicher (Hygienespeicher)	BU~	Brunnenwasser	BGH	Begleitheizung	WFL	Wasserfilter	GW~	Grenzwert (empfohlen: High-,Low_limit verwenden)		
					WWS	Warmwasserstation (Frischwassersta	WG~	Grau-, Brauchwasser	EWH	Elektroheizung *(TWW-Bereitung)*			GWC	Grenzwert berechnet (empfohlen: High-,Low_limit verwenden)		
					HEZ	Wasserstofferzeugung	WGA	Grau-, Brauchwasser-Ablauf			LVB	Lokale Vorrangbedienung	GWH	Grenzwert High (MAX) (empfohlen: High-,Low_limit verwenden)		
							WGZ	Grau-, Brauchwasser-Zulauf	WAZ	Wasserzähler	REP	Reparaturschalter	GWL	Grenzwert Low (MIN) (empfohlen: High-,Low_limit verwenden)		
			AFA	Aufbereitungsanlage	DOS	Dosieranlage	RG~	Regenwasser					HD~	LVB-Handmeldung		
					EHA	Enthärtungsanlage	RGA	Regenwasser-Ablauf	STB	Sicherheitstemperaturbegrenzer	TS~	Temperatur schaltend *(z.B. Thermos*	HDG	Handmeldung Analog		
					UOA	Umkehrosmoseanlage	RGZ	Regenwasser-Zulauf	STW	Sicherheitstemperaturwächter	TSH	Temperatur schaltend hoch	HDB	Handmeldung Binär		
					VEA	Vollentsalzungsanlage							HDA	Handmeldung Binär Auf		
					NEU	Neutralisationsanlage	TW~	Trinkwasser			GS~	Position schaltend, Endschalter	HDZ	Handmeldung Binär Zu		
							TWA	Trinkwasser-Ablauf					HDE	Handmeldung Binär Ein		
			VTA	Verteilanlage	WZN	Wasserzirkulation *(Trinkwasserzirkul*	TWZ	Trinkwasser-Zulauf			HZE	Heizelement	HDS	Handmeldung Binär Aus		

Table 4 BACtwin UAK (excerpt)

2.1.14 Existing Plant

As soon as automation technology is renovated with new automation devices, the BACtwin concept must be implemented. This is done in the knowledge that different BA concepts and philosophies can be in operation in parallel until the BACtwin concept is implemented throughout the entire property.

In the transition phase, it may be advantageous for the operator in individual cases to migrate the inventory, at least in basic terms, to the BACtwin concept within the scope of technical and economic possibilities.

A translation according to 2.1.15 can potentially transform an existing UAK into a machine-interpretable BACtwin UAK that has the advantages of automatable check routines.

2.1.15 Translation of existing UAK

By translating existing UAK, old BA systems can be adapted to a consistent operator concept (e.g. alarm management using Notification Class according to the BACtwin concept) or old systems can be integrated into a BACtwin based TMon monitoring.

Translations can also be advantageous when renovating or migrating automation devices and when automatically creating MOU system images.

To test the feasibility, an operator has developed an EXCEL-based tool that enables automated translation of large parts of their own existing UAK into the BACtwin UAK. The practical test using the example of a high-tech building with around 4,000 data points and a well-structured existing UAK showed that a large proportion of the data points could be translated automatically. The other data points had to be clarified manually using diagrams and descriptions.

The UAK translation worksheet (table 5) presents the inventory data and the automatically translated BACtwin UAK as an example. The special cases that need to be clarified are marked in color.

Based on this experience, AI-based BACtwin converters are expected to be able to process UAK of existing systems and map them to the BACtwin standard.

# keyname	device obj.-instance	object-name	Gebäude	Gewerk	Anlage	Anl.-Nr.	Teil-Anl.	Baugruppe	Baugruppen-Nr.	Medium, Position	Aggregat	Aggregat-Nr.	Betriebsmittel	Betriebsmitte-Nr.	Funktion	Anhang	Funktion-Nr.	BAS neu	Länge
3329/01	3329001	3329'IP01'SSC01'DDC01'SY97	3329	480	ASP	01		###	##	###	ASE	01	###	##	DEV		01	3329_480_ASP01__#####_###_ASE01_#####_DEV01	43
3329/01/110/00/00/P.12/CDI/k	3329001	3329'ER31'DIG01'INT01'BM55	3329	470	LAB	31		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB31__DIG01_###_#####_#####_BM~01	43
3329/01/110/00/00/P.11/CDI/k	3329001	3329'ER31'DIG01'INT02'BM55	3329	470	LAB	31		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB31__DIG01_###_#####_#####_BM~01	43
3329/01/110/00/00/P.13/CDI/k	3329001	3329'ER31'DIG01'INT03'SM73	3329	470	LAB	31		DIG	01	###	###	##	###	##	SSM		01	3329_470_LAB31__DIG01_###_#####_#####_SSM01	43
3329/01/109/00/00/P.62/CDI/k	3329001	3329'ER34'DIG01'INT01'BM55	3329	470	LAB	34		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB34__DIG01_###_#####_#####_BM~01	43
3329/01/109/00/00/P.61/CDI/k	3329001	3329'ER34'DIG01'INT02'BM55	3329	470	LAB	34		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB34__DIG01_###_#####_#####_BM~01	43
3329/01/109/00/00/P.63/CDI/k	3329001	3329'ER34'DIG01'INT03'SM73	3329	470	LAB	34		DIG	01	###	###	##	###	##	SSM		01	3329_470_LAB34__DIG01_###_#####_#####_SSM01	43
3329/01/109/00/00/P.64/CDI/k	3329001	3329'ER40'DIG01'INT02'BM55	3329	470	LAB	40		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB40__DIG01_###_#####_#####_BM~01	43
3329/01/110/00/00/P.02/CDI/k	3329001	3329'ER40'DIG01'INT03'SM73	3329	470	LAB	40		DIG	01	###	###	##	###	##	SSM		01	3329_470_LAB40__DIG01_###_#####_#####_SSM01	43
3329/01/110/00/00/P.04/CDI/k	3329001	3329'ER46'DIG01'INT01'BM55	3329	470	LAB	46		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB46__DIG01_###_#####_#####_BM~01	43
3329/01/110/00/00/P.03/CDI/k	3329001	3329'ER46'DIG01'INT02'BM55	3329	470	LAB	46		DIG	01	###	###	##	###	##	BM~		01	3329_470_LAB46__DIG01_###_#####_#####_BM~01	43
3329/01/110/00/00/P.05/CDI/k	3329001	3329'ER46'DIG01'INT03'SM73	3329	470	LAB	46		DIG	01	###	###	##	###	##	SSM		01	3329_470_LAB46__DIG01_###_#####_#####_SSM01	43
3329/01/000/91/03/S336.01/5574	3329001	3329'IP01'SSC01'ATF01'SM00	3329	480	ASP	01		###	##	AU~	EF~	01	T~~	01	#NV		01	#NV	#NV
3329/01/000/00/00/SY_MsgOut.01/CB_NC	3329001	3329'IP01'SSC01'DDC01'GM98	3329	480	ASP	01		###	##	###	ASE	01	###	##	NC~		01	3329_480_ASP01__#####_###_ASE01_#####_NC~01	43
3329/01/000/00/00/SY_MsgOut.04/CB_NC	3329001	3329'IP01'SSC01'DDC01'HM98	3329	480	ASP	01		###	##	###	ASE	01	###	##	NC~		01	3329_480_ASP01__#####_###_ASE01_#####_NC~01	43
3329/01/000/00/00/SY_MsgOut.02/CB_NC	3329001	3329'IP01'SSC01'DDC01'SM98	3329	480	ASP	01		###	##	###	ASE	01	###	##	NC~		01	3329_480_ASP01__#####_###_ASE01_#####_NC~01	43
3329/01/000/91/03/S066.03/2	3329001	3329'IP01'SSC01'DDC01'WM17	3329	480	ASP	01		###	##	###	ASE	01	###	##	WM~		01	3329_480_ASP01__#####_###_ASE01_#####_WM~01	43
3329/01/000/00/00/SY_MsgOut.03/CB_NC	3329001	3329'IP01'SSC01'DDC01'WM98	3329	480	ASP	01		###	##	###	ASE	01	###	##	NC~		01	3329_480_ASP01__#####_###_ASE01_#####_NC~01	43
3329/01/002/00/00/P.25/CDI/k	3329001	3329'IP01'SSC01'INT01'GM75	3329	480	ASP	01		###	##	###	SSK	01	###	##	#NV		01	#NV	#NV
3329/01/002/00/00/P.26/CDI/k	3329001	3329'IP01'SSC01'INT02'SM70	3329	480	ASP	01		###	##	###	SSK	01	MCB	01	SM~		01	3329_480_ASP01__#####_###_SSK01_MCB01_SM~01	43
3329/01/002/00/00/P.27/CDI/k	3329001	3329'IP01'SSC01'INT03'SM70	3329	480	ASP	01		###	##	###	SSK	01	MCB	01	SM~		01	3329_480_ASP01__#####_###_SSK01_MCB01_SM~01	43
3329/01/002/00/00/P.01/CDI/k	3329001	3329'IP01'SSC01'INT04'HM45	3329	480	ASP	01		###	##	###	SSK	01	###	##	ETR		01	3329_480_ASP01__#####_###_SSK01_#####_ETR01	43
3329/01/002/00/00/P.32/CDO/K	3329001	3329'IP01'SSC01'INT05'SB73	3329	480	ASP	01		###	##	###	SSK	01	LAM	01	SBE		01	3329_480_ASP01__#####_###_SSK01_LAM01_SBE01	43
3329/01/002/00/00/P.28/CDI/k	3329001	3329'IP01'SSC01'INT06'SM72	3329	480	ASP	01		###	##	###	SSK	01	EHF	01	SM~		01	3329_480_ASP01__#####_###_SSK01_EHF01_SM~01	43
3329/01/002/00/00/P.29/CDI/k	3329001	3329'IP01'SSC01'INT07'SM71	3329	480	ASP	01		###	##	###	SSK	01	EPH	01	SM~		01	3329_480_ASP01__#####_###_SSK01_EPH01_SM~01	43
3329/01/002/00/00/P.30/CDI/k	3329001	3329'IP01'SSC01'INT08'HM40	3329	480	ASP	01		###	##	###	SSK	01	HS~	01	WM~		01	3329_480_ASP01__#####_###_SSK01_HS~01_WM~01	43
3329/01/002/00/00/P.31/CDI/k	3329001	3329'IP01'SSC01'INT09'HM42	3329	480	ASP	01		###	##	###	SSK	01	LVB	01	HD~		01	3329_480_ASP01__#####_###_SSK01_LVB01_HD~01	43
3329/01/000/91/99/M.01/1	3329001	3329'IP09'SSC01'DDC03'IM59	3329	480	ASP	09		###	##	###	ASE	03	###	##	#NV		01	#NV	#NV
3329/01/000/91/99/M.02/6	3329001	3329'IP09'SSC01'DDC03'SM74	3329	480	ASP	09		###	##	###	ASE	03	###	##	#NV		01	#NV	#NV

Table 5 UAK translation (example)

2.1.16 Customize BACtwin UAK (with example)

The logical structure and data volume of the BACtwin UAK must be used in such a way that the BACtwin systems can be addressed and monitored in a machine-interpretable form.

Even smaller buildings are increasingly being equipped with complex technology (e.g. photovoltaics, heat pumps). As complexity increases, the need for differentiated monitoring continues to increase.

A reduction of the BACtwin UAK e.g. B. in a smaller BA project with BA standalone operation would affect the automated test routines. In a networked BA system, a reduced UAK would cause a system break and make automated system-wide BAC evaluations impossible. The advantages of easy auditability in the sense of the German [Gebäudeenergiegesetz] would be lost without bringing about adequate other advantages.

Builders/operators are recommended to select the options available in the data model for adapting the BACtwin UAK based on their needs (e.g. number of digits for numbering) and to specify them system-wide in the operator requirement (see Table 27 Operator requirement). Structural changes to the BACtwin UAK are not recommended.

Due to a lack of personnel, cost pressure, environmental protection, standards, etc., the networking of BAC systems across buildings and locations continues to increase.

A uniform BACtwin UAK is an advantage for an organization-wide networked BA system. When introducing the BACtwin UAK structure, it is important to consider the property with the most complex UAK requirements. The addressing of room automation and partial plants as well as future buildings must be taken into account.

If room automation or partial plants are to be expected in a property, the corresponding expansion must be provided in the UAK block system. When addressing BA systems without room automation and without Partial plants, the unused positions must be filled with hash marks (#).

The following figure shows an example of an organization-wide UAK of a state administration (with Location UAK and BACtwin UAK).

The example in Figure 3 (in contrast to the example in Table 2) also addresses partial plants and uses a total of 63 digits.

In Library 1, the example is available as worksheet 4.1 UAK Example in editable table form.

Figure 3 UAK (example of a state administration)

2.2 AMEV profile

In addition to the standardized UAK, uniform BACnet minimum requirements must be met to ensure planning, engineering and operation of the BACnet systems through predefined standards.

The AMEV recommendation [AMEV BACnet 2017] defines the AMEV profiles AS-A and AS-B for automation stations based on BACnet Revision 12 and describes a procedure for creating AMEV attestations for these AMEV profiles. BACnet manufacturers have currently had AMEV attestations created for around 240 AS models. In the D-A-CH area, the AMEV profile AS-B is used as standard.

In order to be able to implement the BACtwin concept promptly, the AMEV profiles for automation stations are being further developed in two stages as AMEV profiles AS-C and AS-D.

Important innovations in the AMEV profile AS-C and AS-D are shown in Figure 3.

AMEV profile	Overview of important innovations
AS-C	Introduction of **additional properties from revisions 14 and 16**
	Higher **minimum number of characters of properties** according to Tab. K4 of the BACnet standard
	Introduction of selected **Event_Parameter** of the object type Event_Enrollment
	Requirements for **Calendar and Schedule objects** slightly modified
AS-D	Introduction of the additional object type **Structured_View**

Figure 4 New features in the AMEV profile AS-C and AS-D

The AMEV profile AS-D includes the AMEV profile AS-C and the Structured View (SV) object type. The BACtwin concept uses the SV objects for the modular representation of the system structures and the data content of standardized aggregates, assemblies and plants. This enables the automation of time-consuming and error-prone manual processes (e.g. data transfer, documentation, testing).

The BACtwin library 2 defines in Table 6 the BIBBs, object types, properties, conformance codes and other performance features to be supported by the AMEV profile AS-C and AS-D in the sense of a minimum requirement as a test table.

The table below shows an excerpt from the test table for the new AMEV profiles.

The procedure for creating the AMEV attestations defined in the AMEV recommendation [AMEV BACnet 2017] has proven itself and is also used for new automation stations with the AMEV profiles AS-C and AS-D.

The form of AMEV attestation for profile AS-C and AS-D is shown in Appendix 1.

The integration of the SV objects into new AS with AMEV profile AS-D should be strived for as soon as possible. In order to avoid market restrictions for AS with AMEV profile AS-D, the SV object is initially only required in planning tools and in the exchange format. The AMEV profile AS-D can be required as soon as several AS with an attestation for the AMEV profile AS-D are available.

Proprietary BACnet objects are not allowed for standard BA functions. The replacement of standardized BACnet objects, properties and services with manufacturer-specific ones is not permitted.

When engineering the BACnet devices, all BACnet objects and properties used must be created visibly so that they can be easily recognized by common BACnet testing tools.

AMEV-Profile AS-C und AS-D
(Prüftabelle)

1. Allgemeine Angaben

Anbieter	
Vendor ID	
Typ Nummer	
Firmware-Revision	
Prüf-Bericht	

Profil AS-C

2. BIBBs

BIBBs	Vorgabe	geprüft
1	2	3
DS-RP-A	X	
DS-RP-B	X	
DS-RPM-A	X	
DS-RPM-B	X	
DS-WP-A	X	
DS-WP-B	X	
DS-WPM-B	X	
DS-COV-A	X	
DS-COV-B	X	
AE-N-I-B	X	
AE-ACK-B	X	
AE-ESUM-B	X	
AE-INFO-B	X	
SCHED-I-B	X	
DM-DDB-A	X	
DM-DDB-B	X	
DM-DOB-B	X	
DM-DCC-B	X	
DM-TS-B	X[T]	
DM-UTC-B	X[T]	
DM-RD-B	X	
DM-BR-B	X	
DS-COVP-B	X	
AE-N-E-B	X	
AE-ASUM-B	X	
SCHED-E-B	X	
T-VMT-I-B	X	
T-VMT-E-B	X	
T-ATR-B	X	
DM-OCD-B	X	

3. Objekttypen und DC/DD-Fähigkeiten

Objekttyp	Vorgabe	geprüft
1	2	3
AI	X	
AO	X	
AV	X	
BI	X	
BO	X	
BV	X	
CAL (mit DC/DD)	X	
DEV	X	
EE (mit DC/DD)	X	
FIL	X	
LP	X	
MI *	X	
MO *	X	
MV	X	
NC (mit DC/DD)	X	
SCH (mit DD(DC)	X	
TL (mit DC/DD)	X	

Profil AS-D

2. BIBBs

BIBBs	Vorgabe	geprüft
1	2	3
DS-RP-A	X	
DS-RP-B	X	
DS-RPM-A	X	
DS-RPM-B	X	
DS-WP-A	X	
DS-WP-B	X	
DS-WPM-B	X	
DS-COV-A	X	
DS-COV-B	X	
AE-N-I-B	X	
AE-ACK-B	X	
AE-ESUM-B	X	
AE-INFO-B	X	
SCHED-I-B	X	
DM-DDB-A	X	
DM-DDB-B	X	
DM-DOB-B	X	
DM-DCC-B	X	
DM-TS-B	X[T]	
DM-UTC-B	X[T]	
DM-RD-B	X	
DM-BR-B	X	
DS-COVP-B	X	
AE-N-E-B	X	
AE-ASUM-B	X	
SCHED-E-B	X	
T-VMT-I-B	X	
T-VMT-E-B	X	
T-ATR-B	X	
DM-OCD-B	X	

3. Objekttypen und DC/DD-Fähigkeiten

Objekttyp	Vorgabe	geprüft
1	2	3
AI	X	
AO	X	
AV	X	
BI	X	
BO	X	
BV	X	
CAL (mit DC/DD)	X	
DEV	X	
EE (mit DC/DD)	X	
FIL	X	
LP	X	
MI *	X	
MO *	X	
MV	X	
NC (mit DC/DD)	X	
SCH (mit DD(DC)	X	
SV	X	
TL (mit DC/DD)	X	

Table 6 AMEV profile AS-C and AS-D (check table - excerpt)

2.3 Object template

An object template serves as a building block for defining standard aggregates according to the modular principle. An object template defines a standard BA function using a BACnet object, the properties of this object and the recommended parameters.

The object templates are sorted according to object types and compiled into object-specific object templates (XLSX worksheets) as follows in the Library 2:

Table 8.1	AI templates	Table 8.8	LP templates
Table 8.2	AO und AV templates	Table 8.9	MI templates
Table 8.3	BI templates	Table 8.10	MO und MV templates
Table 8.4	BO und BV templates	Table 8.11	NC templates
Table 8.5	CAL templates	Table 8.12	SCH templates
Table 8.6	DEV templates	Table 8.13	SV templates
Table 8.7	EE templates	Table 8.14	TL templates

Table 7 Object templates (overview)

The 14 worksheets define the object templates with the necessary standardized BACnet and BA information. The goal is for a BACnet-based standard to be available for every common BA function.

Each object template receives a unique identifier, which enables the template properties to be passed on to other information carriers, and a name in plain text.

The object template identifier includes several parts that are formed from abbreviations based on the UAK and use underscores as separators:

1. **OBJ** abbreviation of the **object type**, three digits (e.g. **AI** = analog input)
2. **FCT** abbreviation of the **OE function**, two/three digits (e.g. **MS** = reading)
3. **Suffix** optional, indicates **variants**, one/multi-part (e.g. **T** = temperature)
4. **Version** names the **source and version** of the template (e.g. **AMEV1**)

Example Object template
Hot water temperature reading **AI_MS_T_H_WM_AMEV1**

The example names 1. an AI object that 2. records and displays the measured value for 3. the hot water temperature and 4. is defined as version AMEV1.

For complex object types, the OE function (2nd part) in the template identifier is omitted.

The **Table 8 AI template en (example)** below shows the AI object templates as an example.

For each AI template, Table 8 names the object template identifier, the plain text name, the properties to be parameterized and checked and the recommended parameters (e.g. units of measured values and limit values for error messages).

The recommended default value or value range is defined for each property to be parameterized (shown in orange). Sensible adjustment of recommended values in consultation with the building owner/operator is permissible (see e.g. 4.6.1 Regulation).

Parameters in square brackets [ ] are permissible value ranges. These default values must be set in the project to values that make sense for the project (e.g. measured pressure value in air conditioning plants, parameters for COV_Increment, Low_Limit, High_Limit).

If the value of a property is not parameterized but is generated internally within the system and requires testing, the recommended testing value is defined (shown in turquoise).

The implementation of the properties to be parameterized takes place in three steps:
1. Basic specification 2. Detailed definition 3. Implementation.

The responsibilities for the three steps are identified by code letters:
B = builder/operator **P** = BA planning **X** = executing company.

Responsibility lies with the executing company for properties that only require inspection.

The object templates are sorted according to the PropSort column. The structure and use of the PropSort identifier are explained in Section 2.7.

The BACS Function List entries column names necessary entries in the BA function list (with area and column as well as number of the respective BA function) according to [VDI 3814 Blatt 4.3]. The information must be automatically transferred to the project-specific BACS-FL list by the BA planning software.

Each object template has a UUID (Universally Unique Identifier), which supports the import and use of templates in databases without naming conflicts (column B).

Library 2 completely represents the standardized object templates in Worksheet 8.1 to 8.14.

In each table the English-language object templates (outlined in red) are below the German-language object templates.

Additional required standardized object templates can be communicated to the AMEV (see 4.11).

If an additional, non-standard object template is required in a project-specific special case, BA planning can generate a **special object template** in the planning software by modifying a standard object template.

The newly generated special object template must receive a unique special object identifier and a plain text name.

The special object identifier should be based on the identifier of available standard object templates and the BACtwin UAK. Due to the project-specific modeling, AMEV1 is omitted as a source and version. Instead of AMEV1, a unique designation of the builder's or operator's choice must be specified (e.g. name, version).

Example Special object identifier
Temperature reading **AI_MS_T_NAME1**

In addition, each special object template must have a UUID that supports the import and use of the template in databases without naming conflicts.

ObjSort + No.	Object Template Identifier	Comment	BACS FL entries (1.1.1)	BACS FL entries (2.2.1)	BACS FL entries (3.1.1)	BACS FL entries (3.1.3)	Object_Name	Application	Status_Flags	Event_State	Reliability	Out_Of_Service	Units	Min_Pres_Value	Max_Pres_Value	Resolution	COV_Increment	Time_Delay	Notification_Class	Low_Limit	High_Limit	Deadband	Limit_Enable	Event_Enable	Notify_Type	Event_Time_Stamps	Event_Message_Texts	Event_Message_Texts_Config	Event_Detection_Enable	Event_Algorithm_Inhibit[_Ref]	Time_Delay_Normal	Reliability_Evaluation_Inhibit
	PropSort						a11						b11	c45	c46	b41	b17	c43	c11	c47	c48	c50	c49	c12	c13			c14	c15	c41[, c42]	c44	
	Conformance Code						R		R	R	W[1]	W	W	R	R	R	W	W	W	W	W	W	W	W	W	R	R	W	W	R[X]	W	R[X]|O
	Basic spezification *						B *						B	P	P	P	B	P	B	P	P	P	P	B	B			B	B	P	P	
	Detailed definition *						P *						P	P	P	P	P	P	P	P	P	P	P	P	P			P	P	P	P	
	Implementation *						X *		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	Default value (parameterization)						ja		no	no	no	no	yes	no	no	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	no	yes	no
a101	AI_MW_T_AMEV1	Temperature	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				> 0	> 0	fix	[fix]	[fix]	fix	fix	{t,t,t}	Alarm	*	*	***	{t}		1	
a102	AI_MW_T_AU_AMEV1	Temperature outside	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,2	120	300	[-20]	[40]	0,2	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a103	AI_MW_T_H_NT_AMEV1	Heating Low Temperature	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,5	1	300	[10]	[50]	0,5	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a104	AI_MW_T_H_HT_AMEV1	Heating High Temperature	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				1	1	300	[10]	[90]	1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a105	AI_MW_T_H_HW_AMEV1	Sensor Temperature Hot water	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				1,5	1	300	[10]	[160]	1,5	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a106	AI_MW_T_H_TO_AMEV1	Sensor Temperature Thermo Oil	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				3	1	300	[0]	[300]	3	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a107	AI_MW_T_H_WW_AMEV1	Sensor Temperature Warm water	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				1	60	300	[55]	[75]	1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a108	AI_MW_T_H_AG_AMEV1	Sensor Temperature Exhaust Gas	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				10	1	300	[-20]	[1300]	10	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a109	AI_MW_T_L_RU_AMEV1	Sensor Temperature Ventilation Room	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,5	60	300	[5]	[40]	0,5	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a110	AI_MW_T_L_TP_AMEV1	Sensor Temperature Dew point	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,1	60	300	[10]	[20]	0,1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a111	AI_MW_T_K_NT_AMEV1	Sensor Temperature Cold Low Temperature	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,1	60	300	[4]	[14]	0,1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a112	AI_MW_T_K_HT_AMEV1	Sensor Temperature Cold High Temperature	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,1	60	300	[12]	[22]	0,1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a113	AI_MW_T_K_KW_AMEV1	Sensor Temperature Cold water	X	X	X	X	[UAK]	Temperature Reading	{f,f,f,f}	0	0	{f}	°C				0,5	60	300	[-20]	[45]	0,5	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a114	AI_MW_X_L_RU_AMEV1	Sensor Humidity absolute Room	X	X	X	X	[UAK]	Humidity absolute Reading	{f,f,f,f}	0	0	{f}	g/m³				0,1	240	300	[4]	[11,5]	0,1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a115	AI_MW_X_L_AU_AMEV1	Sensor Humidity absolute Outside	X		X	X	[UAK]	Humidity absolute Reading	{f,f,f,f}	0	0	{f}	g/m³				0,1						{f,f}	{t,t,t}	Alarm	*	*	***	{f}		1	
a116	AI_MW_M_L_RU_AMEV1	Sensor Humidity 0-100% RH Room	X	X	X	X	[UAK]	Humidity relative Reading	{f,f,f,f}	0	0	{f}	%r.F.				3	240	300	[30]	[70]	3	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a117	AI_MW_M_L_AU_AMEV1	Sensor Humidity 0-100% RH Outside	X		X	X	[UAK]	Humidity relative Reading	{f,f,f,f}	0	0	{f}	%r.F.				3						{f,f}	{t,t,t}	Alarm	*	*	***	{f}		1	
a118	AI_MW_P_AMEV1	Sensor Pressure	X	X	X	X	[UAK]	Pressure Reading	{f,f,f,f}	0	0	{f}	Pa				fix	fix	300	[fix]	[fix]	[fix]	fix	{t,t,t}	Alarm	*	*	***	{t}		1	
a119	AI_MW_P_GAS_AMEV1	Sensor Compressed Gas (e.g. natural gas, technical gases)	X	X	X	X	[UAK]	Pressure Reading	{f,f,f,f}	0	0	{f}	bar				fix	fix	300	[fix]	[fix]	[fix]	fix	{t,t,t}	Alarm	*	*	***	{t}		1	
a120	AI_MW_P_GM_AMEV1	Sensors Compressed Gas Hazard (see NC100)	X	X	X	X	[UAK]	Pressure Reading	{f,f,f,f}	0	0	{f}	bar				fix	fix	100	[fix]	[fix]	[fix]	fix	{t,t,t}	Alarm	*	*	***	{t}		1	
a121	AI_MW_P_L_AMEV1	Sensor Pressure 0-1000Pa Ventilation	X	X	X	X	[UAK]	Pressure Reading	{f,f,f,f}	0	0	{f}	Pa				[30]	120	300	[0]	[500]	[30]	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a122	AI_MW_P_Tem_AMEV1	Sensor Pressure 0-10bar heating	X	X	X	X	[UAK]	Pressure Reading	{f,f,f,f}	0	0	{f}	bar				0,1	30	300	[1,5]	[5]	0,1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a123	AI_MW_PD_L_AMEV1	Sensor Differential Pressure 0-5000/[+-50 ring scale]Pa differentia	X	X	X	X	[UAK]	Pressure difference Reading	{f,f,f,f}	0	0	{f}	Pa				[150/3	120	300	[0/-40	[500/40	[150/3]	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1/120	
a124	AI_MW_PD_Tem_AMEV1	Sensor Differential Pressure 0-5.5bar differential pressure heating	X	X	X	X	[UAK]	Pressure difference Reading	{f,f,f,f}	0	0	{f}	bar				0,1	30	300	[1,5]	[5]	0,1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a125	AI_MW_F_AMEV1	Sensor Volume Flow Counter, Volume Flow Controller	X	X	X	X	[UAK]	Volume flow Measured value	{f,f,f,f}	0	0	{f}	m³/h				fix	fix	300	[fix]	[fix]		fix	{t,t,t}	Alarm	*	*	***	{t}		1	
a126	AI_MW_J_AMEV1	Sensor Power Counter	X	X	X	X	[UAK]	Performance Metric	{f,f,f,f}	0	0	{f}	kW				fix	fix	300	[fix]	[fix]		fix	{t,t,t}	Alarm	*	*	***	{t}		1	
a127	AI_MW_QCD_AMEV1	Sensor CO2 Carbon dioxide	X	X	X	X	[UAK]	CO2 Reading	{f,f,f,f}	0	0	{f}	ppm				50	3600	300	[400]	[1200]	50	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a128	AI_MW_QCO_AMEV1	Sensor CO Carbon monoxide	X	X	X	X	[UAK]	CO Reading	{f,f,f,f}	0	0	{f}	ppm				[1]	3600	200	[0]	[30]	1	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a129	AI_MW_QPH_AMEV1	Sensor Conductivity	X	X	X	X	[UAK]	PH Reading	{f,f,f,f}	0	0	{f}	pH				[0,1]	3600	300	[6]	[8]	[0,1]	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a130	AI_MW_E_RU_AMEV1	Sensor Illuminance Room	X	X	X	X	[UAK]	Illuminance Reading	{f,f,f,f}	0	0	{f}	lx				50	3600	300	0	[1000]	50	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a131	AI_MW_E_AU_AMEV1	Sensor Illuminance Outside	X		X	X	[UAK]	Illuminance Reading	{f,f,f,f}	0	0	{f}	lx				50	3600	300				{f,f}	{f,t,t}	Alarm	*	*	***	{t}		1	
a132	AI_MW_R_AU_AMEV1	Sensor Global Radiation Outside	X		X	X	[UAK]	Global radiation Reading	{f,f,f,f}	0	0	{f}	W/m²				50	3600	300				{f,f}	{f,t,t}	Alarm	*	*	***	{t}		1	
a133	AI_MW_L_AMEV1	Sensor Level	X	X	X	X	[UAK]	Level Reading	{f,f,f,f}	0	0	{f}	[%]				[0,5]	3600	300	[20]	[100]	[1]	{t,t}	{t,t,t}	Alarm	*	*	***	{t}		1	
a134	AI_RW_AMEV1	Feedbackk value	X		X	X	[UAK]	Feedbackk value	{f,f,f,f}	0	0	{f}	%				3	60	300	[0]	[100]	3	{f,f}	{f,t,t}	Alarm	*	*	***	{t}		1	
a135	AI_MW_WIG_AMEV1	Sensor: Thermal Anemometer/Star Anemometer	X		X	X	[UAK]	Wind speed Reading	{f,f,f,f}	0	0	{f}	m/s				0,1	60	300				{f,f}	{f,t,t}	Alarm	*	*	***	{t}		1	
a136	AI_MW_RW_AMEV1	Performance feedback	X		X	X	[UAK]	Performance Feedback	{f,f,f,f}	0	0	{f}	%				3	60	300	[0]	[100]	3	{f,f}	{f,t,t}	Alarm	*	*	***	{t}		1	
a137	AI_MW_LTF_AMEV1	Conductivity	X		X	X	[UAK]	Conductivity Measured Value	{f,f,f,f}	0	0	{f}	S/m				[0,1]	60	300				{f,f}	{f,t,t}	Alarm	*	*	***	{t}		1	
a138	AI_SW_J_AMEV1	Setpoint Power (feed-in)	X	X	X	X	[UAK]	Power Setpoint	{f,f,f,f}	0	0	{f}	%				fix	fix	300	[fix]	[fix]		fix	{t,t,t}	Alarm	*	*	***	{t}		1	

** B (Builder/Operator), P (Planning), X (Executing Company)*

Default value (parameterization) and test value
Test value (internally generated value)

{} => Default value (suggestion)

** Can be used for testing in the 1:1 test*
**** Implementation according to Chapter 4.5*

Table 8 AI template en (example)

2.4 Aggregate template

2.4.1 Standard aggregate

An aggregate template configures a **standard aggregate** according to the modular principle using predefined object templates. Aggregate templates serve as components for defining standard assemblies and standard plants.

An aggregate template defines a practical standard set of BA functions for a standard aggregate (e.g. single-stage pump). Available best practice solutions are taken into account (e.g. specifications according to [AMEV TMon 2020]).

For the standard aggregate, the required object templates are selected from the BACtwin library and configured as an aggregate template using the identifiers of the object templates. The aggregate template defines the BA equipment of the standard aggregate based on the object templates used and - through inheritance - also the associated properties and parameters.

Each aggregate template receives a unique identifier, which enables the template properties to be passed on to other information carriers, and a plain text label.

The aggregate identifier includes several parts that are formed from abbreviations based on the UAK and use underscores as separators:

1.	**AGG**	type of **template**, three digits	(e.g. **AGG** = aggregate)
2.	**PMP**	abbreviation of the **aggregate**, three digits	(e.g. **PMP** = pump)
3.	**Suffix**	optional, indicates **variants**, one/multi-part	(e.g. **S1** = single-stage)
4.	**Version**	names the **source and version** of the template	(e.g. **AMEV1**)

Example aggregate identifier
Single-stage pump **AGG_PMP_S1_AMEV1**

As an example, the single-stage pump aggregate template is shown in Table 9:

Aggregate identifier	**Aggregate designation**
AGG_PMP_S1_AMEV1	**Single-stage pump**
Objekt-Template	**Objekt Description (Auszug)**
SV_AGG	pump
BO_SC[1]	switching command
EE_CMDF[1]	execution control
BI_OMS	operating message
TL_BN	recording operating message
BI_FM	fault message
EE_CCP	manual message UBE (Priority_Array) (ab Rev. 22 Required)
BI_LOM[2]	Local override message (LO/ID)
MV_HD_AEM[2]	
EE_COB[2]	

[1] **Execution control** with Intrinsic Reporting (BO) or Algorithmic Reporting (additionally EE).
[2] **Manual reporting of a local priority operation** (LO/ID) with BI, MV or EE object.

Table 9 Example Aggregate template: single-stage pump

The data points of the single-stage pump are explained below as examples.

The aggregate template begins with a Structured View object (condition: AS with AMEV profile AS-D). It names the aggregate template (e.g. SV_AGG_PMP_S1_AMEV1) and maps the structure of the aggregate template and the associated object templates. Further explanations of the SV object follow in Section 2.7 Structured_View Objects.

The pump has a switching command (BO_SC 1), the operating message (BI_OMS) and a fault message (BI_FM).

For a single-stage pump, the **switching command** is usually used to switch the motor using a closing relay on the AS. The operating message can come from the pump directly (potential-free contact) or, if necessary, from an auxiliary contact of the power contactor.

The **operating message** data recording records the operating status of the pump (ON/OFF with time stamp) and is used for energy reasons (e.g. TMon evaluation).

The **fault message** can be generated directly from the pump (potential-free contact as a break contact) or from an auxiliary contact (break contact) of the electrical protection device.

The **execution control** monitors whether the operating message corresponds to the switching command. For example, a switching command may be present, but the pump is not running. Or there is an operating message (pump pumps water) even though there is no switching command (unnecessary energy consumption, possibly hydraulic problems). The execution control can be implemented either with intrinsic reporting of the BO_SB or with an additional EE object (EE_CMDF) (footnote 1). In both cases, the BACnet event algorithm Command_Failure is used.

The **manual message** UBE (Universal Control Unit) is a generic term for an intervention via an MOU a display or another control unit in order to influence the priority control of the pump. Only the entries in the Property Priority_Array that do not represent automatic operation are displayed (see Section 4.3). In the future (i.e. from Rev. 22) a property Current_Command in an EE object should report the manual message UBE.

The **local override message** LO/ID[2] (local override/indication device) indicates that a local intervention has taken place after the automatic operation of the pump switching command. The LO/ID hand report can only be withdrawn at the LO/ID.

Builders or operators must take possible variants into account when configuring.

Variant 1.1	**BO_SC[1]**	Intrinsic reporting delivers the desired function.
Variant 1.2	**EE_CMDF[1]**	Algorithmic reporting provides verifiable information.

Figure 5 Command execution control by means of BO or EE object (examples)

The **execution control** can be implemented with intrinsic reporting (e.g. BO object) or algorithmic reporting (additional EE object) (variant 1). In the aggregate templates with execution control, a suitable object template is defined for each variant 1.1 and 1.2 (see Figure 6).

Variant 2.1	**BI_LOM[2]**	The BI object only shows the manual intervention, but not the status of the intervention; can be implemented by all manufacturers.
Variant 2.2	**MV_LOM_AEM[2]**	The MV object displays the manual intervention and the status of the local intervention; can be achieved by many manufacturers.

Variant 2.3	**EE_COB**[2]	The EE object displays the manual intervention and the status of the local intervention; can be achieved by many manufacturers.

Figure 6 Local overdrive message (LO/ID) using BI, MV or EE object (examples)

The **Local overdrive message** (LO/ID) can be implemented with BI, MV/MI or EE objects (variant 2).

Each variant reports a manual signal (LO/ID), which may lead to increased energy consumption by overriding the automated control of a device (e.g. pump, fan, valve).

In the aggregate templates with Local overdrive message (LO/ID), a suitable object template is defined for each variant 2.1, 2.2 and 2.3 (see Figure 5). The builder or operator should not make decisions about permissible variants in each individual case, but rather on a needs-based basis (e.g. according to the operator concept) and documented as operator requirements across projects and properties (see Section 4.11).

Analogous to the single-stage pump, the aggregate templates in the BACtwin library define the recommended data points of common aggregates. With standard aggregates, the energetically relevant information is recorded in order to use the trend logs, e.g. B. to be able to use it for TMon evaluations. A central objective is also to be able to automatically check the aggregates and plants against the specifications of the respective templates.

According to Section 71a [Building Energy Act], a non-residential building must be equipped with digital energy monitoring technology, through which continuous monitoring, logging and analysis of the consumption of all main energy sources and all building technical systems can be carried out. The data collected must be made accessible via a common and freely configurable interface so that evaluations can be carried out regardless of the company or manufacturer.

The aggregate templates define consumption meters for energy monitoring according to [AMEV TMon 2020]. The meters support plant, building and comfort monitoring in accordance with [VDI 6041] and provide the necessary information for detecting technical and operational errors and for determining operational parameters (e.g. utilization levels).

The Table 10 below shows an excerpt of templates of standard aggregates.

Library 3 completely displays the aggregate templates for all predefined standard aggregates in worksheet 10 Aggregate-Templates (see column Type: **Aggregate**).

The order of the standard aggregates depends - analogous to BACtwin UAK - on the trades in accordance with DIN 276.

Each aggregate template has a UUID that supports importing and using the standard aggregate in databases without naming conflicts (column C).

The grouping function is enabled for each aggregate (button: 1). Grouping can be done individually (button: +) or for all aggregates at the same time (button: 2).

The Object_Name in column L begins with a "*" as a substitute for the Location UAK.

In addition, Library 3 contains in worksheet 10.1 AggTempl de-en English translations of the names of the aggregate templates.

Additional standard aggregates required can be communicated to the AMEV (see 4.11).

Typ	Gewerk	Aggregate-/Baugruppen-/Anlagen-Template-Kennung	Aggregate-/Baugruppen-/Anlagen-Template-Bezeichnung	Referenziertes Template	Description Präfix: [Orts-BAS]	Description Beispiele aus BAS-Tabelle: [Anlage/Raum]. [Baugruppe]. [Medium, Position]	Description Beispiele aus BAS-Tabelle: [Aggregate]. [Betriebsmittel]. [BM-Funktion]. [BM-Funktions-Erweiterung]	Object_Name Beispiel	Gewerk-Kennung	Anlagen-Kennung	Anlagen-Nummer	Baugruppen-Kennung	Baugruppen-Nummer	Medium, Position	Aggregate-Kennung	Aggregate-Nummer	Betriebsmittel-Kennung	Betriebsmittel-Nummer	BM-Funktions-Kennung	BM-Funktions-Nummer	BM-Funktions-Erweiteru	Kommentar
1		4		6	7	8	9	10	1	1	1	1	1	1	1	1	1	2	2	2	2	
	##	Türen, Tore, Fenster, Sonnenschutz																				
Aggregat	##	AGG_FEN_AME¶1	Fensterkontakt Raumautomation																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster	*480_RARxx_#####_RU"_FENxx_#####_SV"01	480	RAR	xx	###	##	RU"	FEN	xx	###	##	SV"	01		
Aggregat				BI_RM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Endschalter Rückmeldung Auf	*480_RARxx_#####_RU"_FENxx_GS"xx_RMA01	480	RAR	xx	###	##	RU"	FEN	xx	GS"	xx	RMA	01		
Aggregat				TL_BN_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Endschalter Rückmeldung Auf Datenaufzeichn	*480_RARxx_#####_RU"_FENxx_GS"xx_RMA01_	480	RAR	xx	###	##	RU"	FEN	xx	GS"	xx	RMA	01	TL	
Aggregat	##	AGG_FEN_ANT_AME¶1	Fenster mit Antrieb Raumautomation																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster	*480_RARxx_#####_RU"_FENxx_#####_SV"01	480	RAR	xx	###	##	RU"	FEN	xx	###	##	SV"	01		
Aggregat				BO_SB_AME¶1[1]	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Schaltbefehl	*480_RARxx_#####_RU"_FENxx_MOTxx_SB"01	480	RAR	xx	###	##	RU"	FEN	xx	MOT	xx	SB"	01		
Aggregat				EE_CMDF_AME¶1[1]	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Aufführkantrolle	*480_RARxx_#####_RU"_FENxx_MOTxx_AK"01_E	480	RAR	xx	###	##	RU"	FEN	xx	MOT	xx	AK"	01	EE	
Aggregat				BI_RM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Endschalter Rückmeldung Zu	*480_RARxx_#####_RU"_FENxx_GS"xx_RM201	480	RAR	xx	###	##	RU"	FEN	xx	GS"	xx	RMZ	01		
Aggregat				TL_BN_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Endschalter Rückmeldung Zu Datenaufzeichnu	*480_RARxx_#####_RU"_FENxx_GS"xx_RM201_	480	RAR	xx	###	##	RU"	FEN	xx	GS"	xx	RMZ	01	TL	
Aggregat	##	AGG_FEN_ANT_KOM_AME¶1	Fenster mit kommunikativem Antrieb Raumautomation																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster	*480_RARxx_#####_RU"_FENxx_#####_SV"01	480	RAR	xx	###	##	RU"	FEN	xx	###	##	SV"	01		
Aggregat				BI_RM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Endschalter Rückmeldung Zu	*480_RARxx_#####_RU"_FENxx_GS"xx_RM201	480	RAR	xx	###	##	RU"	FEN	xx	GS"	xx	RMZ	01		
Aggregat				TL_BN_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Endschalter Rückmeldung Zu Datenaufzeichn	*480_RARxx_#####_RU"_FENxx_GS"xx_RM201_	480	RAR	xx	###	##	RU"	FEN	xx	GS"	xx	RMZ	01	TL	
Aggregat				AY_ST_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Stellsignal	*480_RARxx_#####_RU"_FENxx_MOTxx_ST"01	480	RAR	xx	###	##	RU"	FEN	xx	MOT	xx	ST"	01		
Aggregat				EE_FLIM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Abweichung	*480_RARxx_#####_RU"_FENxx_MOTxx_ABW01_	480	RAR	xx	###	##	RU"	FEN	xx	MOT	xx	ABW	01	EE	
Aggregat				AI_RW_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Rückführwert	*480_RARxx_#####_RU"_FENxx_MOTxx_RW"01	480	RAR	xx	###	##	RU"	FEN	xx	MOT	xx	RW"	01		
Aggregat				EE_CGP_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Bedieneinheit Hand	*480_RARxx_#####_RU"_FENxx_UBExx_HD"01_E	480	RAR	xx	###	##	RU"	FEN	xx	UBE	xx	HD"	01	EE	
Aggregat				TL_AN_P_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Rückführwert Datenaufzeichnung	*480_RARxx_#####_RU"_FENxx_MOTxx_RW"01_	480	RAR	xx	###	##	RU"	FEN	xx	MOT	xx	RW"	01	TL	
Aggregat				BI_HD_AME¶1[2]	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster LVB Hand	*480_RARxx_#####_RU"_FENxx_LVBxx_HD"01	480	RAR	xx	###	##	RU"	FEN	xx	LVB	xx	HD"	01		
Aggregat				MY_HD_ASGM_AME¶1[2]	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster LVB Hand	*480_RARxx_#####_RU"_FENxx_LVBxx_HD"01	480	RAR	xx	###	##	RU"	FEN	xx	LVB	xx	HD"	01		
Aggregat				EE_COB_AME¶1[2]	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster LVB Hand	*480_RARxx_#####_RU"_FENxx_LVBxx_HD"01_E	480	RAR	xx	###	##	RU"	FEN	xx	LVB	xx	HD"	01	EE	
Aggregat				BI_SM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Störmeldung	*480_RARxx_#####_RU"_FENxx_#####_SM"01	480	RAR	xx	###	##	RU"	FEN	xx	###	##	SM"	01		
Aggregat				BI_WM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Wartungsmeldung	*480_RARxx_#####_RU"_FENxx_#####_WM"01	480	RAR	xx	###	##	RU"	FEN	xx	###	##	WM"	01		
Aggregat				AY_MWC_ZFA_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Raum	Fenster Rückmeldung Zu	*480_RARxx_#####_RU"_FENxx_#####_RM201	480	RAR	xx	###	##	RU"	FEN	xx	###	##	RMZ	01		
Aggregat	##	AGG_FEK_GMA_AME¶1	Fensterkontakt Gefahrenmeldeanlage																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Fernmelde- und IT-Anlagen Gefahrenmeldeanlage Einbruchma	Fenster	*450_GMAxx_EMAxx_###_FENxx_#####_SV"01	450	GMA	xx	EMA	xx	###	FEN	xx	###	##	SV"	01		
Aggregat				BI_AM_ZOF_AME¶1	[Ortsbezug]	Fernmelde- und IT-Anlagen Gefahrenmeldeanlage Einbruchma	Fenster Endschalter Rückmeldung Zu	*450_GMAxx_EMAxx_###_FENxx_GS"xx_RM201	450	GMA	xx	EMA	xx	###	FEN	xx	GS"	xx	RMZ	01		
Aggregat	##	AGG_FEN_FEK_GMA_AME¶1	Fensterkontakt Gefahrenmeldeanlage und Raumautomation kombiniert																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Türen, Tore, Fenster, Sonnenschutz Bereich Raum	Fenster	*330_RABxx_#####_RU"_FENxx_#####_SV"01	330	RAB	xx	###	##	RU"	FEN	xx	###	##	SV"	01		
Aggregat				BI_RM_AME¶1	[Ortsbezug]	Türen, Tore, Fenster, Sonnenschutz Bereich Raum	Fenster Endschalter Rückmeldung Zu	*330_RABxx_#####_RU"_FENxx_GS"xx_RM201	330	RAB	xx	###	##	RU"	FEN	xx	GS"	xx	RMZ	01		
Aggregat				TL_BN_AME¶1	[Ortsbezug]	Türen, Tore, Fenster, Sonnenschutz Bereich Raum	Fenster Endschalter Rückmeldung Zu Datenaufzeichnu	*330_RABxx_#####_RU"_FENxx_GS"xx_RM201_	330	RAB	xx	###	##	RU"	FEN	xx	GS"	xx	RMZ	01	TL	
Aggregat	##	AGG_FEN_FEG1_AME¶1	Fenstergriff Zu/Auf																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Gebäudeautomationssystem	Fenster	*480_RARxx_#####_###_FENxx_#####_SV"01	480	RAR	xx	###	##	###	FEN	xx	###	##	SV"	01		
Aggregat				BI_RM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem	Fenster Fenstergriff Rückmeldung Auf	*480_RARxx_#####_###_FENxx_FEGxx_RMA01	480	RAR	xx	###	##	###	FEN	xx	FEG	xx	RMA	01		
Aggregat				TL_BN_AME¶1	[Ortsbezug]	Gebäudeautomationssystem	Fenster Fenstergriff Rückmeldung Auf Datenaufzeichn	*480_RARxx_#####_###_FENxx_FEGxx_RMA01_	480	RAR	xx	###	##	###	FEN	xx	FEG	xx	RMA	01	TL	
Aggregat	##	AGG_FEN_FEG2_AME¶1	Fenstergriff Zu/Gekippt/Auf																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Gebäudeautomationssystem	Fenster	*480_RARxx_#####_###_FENxx_#####_SV"01	480	RAR	xx	###	##	###	FEN	xx	###	##	SV"	01		
Aggregat				MY_RM_ZKA_AME¶1	[Ortsbezug]	Gebäudeautomationssystem	Fenster Fenstergriff Rückmeldung	*480_RARxx_#####_###_FENxx_FEGxx_RM"01	480	RAR	xx	###	##	###	FEN	xx	FEG	xx	RM"	01		
Aggregat				TL_MS_AME¶1	[Ortsbezug]	Gebäudeautomationssystem	Fenster Fenstergriff Rückmeldung Datenaufzeichnung	*480_RARxx_#####_###_FENxx_FEGxx_RM"01_	480	RAR	xx	###	##	###	FEN	xx	FEG	xx	RM"	01	TL	
Aggregat	##	AGG_TUR_AME¶1	Tür Zu/Auf																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Segment	Tür	*480_RASxx_#####_###_TURxx_#####_SV"01	480	RAS	xx	###	##	###	TUR	xx	###	##	SV"	01		
Aggregat				BI_RM_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Segment	Tür Endschalter Rückmeldung Auf	*480_RASxx_#####_###_TURxx_GS"xx_RMA01	480	RAS	xx	###	##	###	TUR	xx	GS"	xx	RMA	01		
Aggregat				TL_BN_AME¶1	[Ortsbezug]	Gebäudeautomationssystem Segment	Tür Endschalter Rückmeldung Auf Datenaufzeichnung	*480_RASxx_#####_###_TURxx_GS"xx_RMA01_	480	RAS	xx	###	##	###	TUR	xx	GS"	xx	RMA	01	TL	
Aggregat	##	AGG_TUR_AMT_AME¶1	Tür mit Antrieb																			
Aggregat				SY_AGG_AME¶1	[Ortsbezug]	Türen, Tore, Fenster, Sonnenschutz Fassadenanlage Fassade M	Tür	*330_FAAxx_#####_n00_TURxx_#####_SV"01	330	FAA	xx	###	##	n00	TUR	xx	###	##	SV"	01		

Table 10 Aggregate template (example)

2.4.2 Project aggregate

If important BA functions of a standard aggregate do not fit, it can be modified into a project aggregate using only AMEV standard object templates. Advantages of project aggregates can include be:

– Expansion through additional BA functions, e.g. innovative solutions,
– Exchange of unwanted BA functions and using desired BA functions),
– Deselecting BA functions that are not required (e.g. object template for repair switches).

The disadvantages of project aggregates should also be taken into account, e.g. B. the increased individual effort in the planning and testing tools, the increasing lack of transparency of the project data and the possible waiver of energy-, cost- or testing-relevant information.

Before agreeing to project aggregates, builders and operators should carefully consider whether they will permanently improve BA operations or make them more difficult. The transparency of mass data in BA systems must be given high priority.

If the BA planning proposes a project aggregate, it must document the reasons and special features so that the positive effects can be checked by the builder/operator before approval, implemented efficiently during the BA execution and monitored during acceptance and in BA operation.

Builders and operators should pay attention to verifiability and apply strict standards when approving changes to the standard templates. In each individual case, the advantages of changes must clearly outweigh the disadvantages - even in the long term.

Reductions in standard functions or individual changes to standard templates are only permitted in justified special cases.

The two tables below represent examples of project aggregates.

In example 1, an object template of the standard pump aggregate is deselected in one step. The Local override message (LO/ID) can be deselected if, in a special case, a control cabinet is not barrier-free accessible (e.g. ceiling installation of the pump).

Example 1

Standard aggregate	**Project aggregate**	**Aggregate designation**
AGG_PMP_S1_AMEV1	**AGG_PMP_S1_NAME1**	**Single-stage pump**
Object template	**Object template**	**Object description (excerpt)**
SV_AGG	SV_AGG	Pump
BO_SC[1]	*BO_SC*[1]	Switching command
EE_CMDF[1]	*EE_CMDF*[1]	Operational report
BI_OMS	BI_OMS	Execution control
TL_BN	TL_BN	Data recording operating message
BI_FM	BI_FM	Fault message
EE_CCP	EE_CCP	Hand message UBE
BI_LOM o.ä.[2]		not applic.: manual message LO/ID

Table 11 Example project aggregate with an object template deselected

In example 2, two additional object templates are added to the standard pump aggregate in one step.

This allows the operating hours to be recorded, e.g. B. point out necessary maintenance in connection with the pump (e.g. dirt trap).

The inspection report at the repair desk must also be provided if a repair desk is required according to the recognized rules of technology.

Example 2

Standard aggregate	**Project aggregate**	**Aggregate designation**
AGG_PMP_S1_AMEV1	**AGG_PMP_S1_NAME1**	**Single-stage pump**
Object template	**Object template**	**Object description (excerpt)**
SV_AGG	SV_AGG	Pump
BO_SC[1]	BO_SC[1]	Switching command
EE_CMDF[1]	EE_CMDF[1]	Operational report
BI_OMS	BI_OMS	Execution control
TL_BN	TL_BN	Data recording operating message
BI_FM	BI_FM	Fault message
EE_CCP	EE_CCP	Hand message UBE
BI_LOM o.ä.[2]	BI_LOM o.ä.[2]	Handmeldung LO/ID
	AV_MWC_BZ	Additionally: operating hours
	BI_MM_REP	Additionally: repair switch

Table 12 Example project aggregate with two additional object templates

A project aggregate is generated by BA planning selecting a standard aggregate in the planning tool and modifying the standard aggregate template as required.

The modification changes the scope of the BA functions of a standard aggregate.

If only recommended parameters of a standard aggregate are adjusted as required (e.g. when adjusting according to Section 4.6.1), this is not a modification.

A new project aggregate template must receive a unique project aggregate identifier and plain text name based on the standard aggregate used and the BACtwin UAK. Due to the project-specific modeling, AMEV1 is omitted as a source and version. Instead of AMEV1, a unique name of the builder's or operator's choice must be specified (e.g. AGG_PMP_S1_NAME1).

The project aggregate identifier is inserted into the project-specific aggregate list. The aggregate list names the standard and project aggregates and object templates used.

In addition, each project aggregate must be given a UUID that supports the import and use of the project aggregate in databases without naming conflicts.

In order to use the advantages of standardization for project aggregates and e.g. to reduce the necessary additional effort, the project aggregates desired by the operator should be typified as far as possible. Needs-based standardization across the entire property portfolio is recommended when defining the operator requirements (see 4.11).

2.4.3 Special aggregate

The procedure for generating a project aggregate described above also applies mutatis mutandis to generating a special aggregate. The main difference is that a project aggregate only uses standardized object templates and can therefore be checked automatically with little additional effort and risk.

In contrast, a special aggregate uses at least one individually defined object template and is therefore associated with an increased risk with regard to system integration and with additional manual testing effort.

For these reasons, the use of special aggregates should be avoided as far as possible.

2.5 Assembly template

An assembly template configures a **standard assembly** according to the modular principle using standard aggregates and standard BA functions. Assembly templates serve as components for standard plants.

An assembly template defines a practical standard set of BA functions for a standard assembly (e.g. reheater). Available best practice solutions are taken into account (e.g. specifications according to [AMEV TMon 2020]).

For a standard assembly, the appropriate aggregate and object templates are selected from the BACtwin library and configured into the desired assembly template using the respective identifiers. The assembly template defines the standard aggregates and standard BA functions associated with the standard assembly as well as - by means of inheritance - the associated object templates and their properties and parameters.

Each assembly template receives a unique identifier, which enables the object properties to be passed on to other information carriers, and a plain text name.

The assembly identifier includes several parts that are formed from abbreviations based on the UAK and use underscores as separators:

1.	**ASY**	type of the **template**, three digits	(**ASY** = assembly template)
2.	**Typ**	abbreviation of the **assembly**, three digits	(e.g. **RHT** = reheater)
3.	**Suffix**	optional, indicates **variants**, one/multi-part	(not applicable in example)
4.	**Version**	names the **source and version** of the template	(e.g. **AMEV1**)

Example assembly identifier

Reheater	**ASY_RHT_AMEV1**

The Table 13 Assembly template en (overview) below shows the English names of the standardized assembly templates.

In **Library 3**, the assembly templates are shown in full in worksheet 10 (see column Type: **Assembly**). To distinguish them from the object templates used, the identifiers of the aggregate templates used are marked different green.

Each standard assembly has a UUID that supports the import and use of the standard assembly in databases without naming conflicts (column C).

The example BACtwin templates for standard assemblies only cover parts of the assemblies required in BACtwin projects. The BA planning must develop the project assemblies required for the overall function based on BACtwin templates.

A project assembly is generated in the planning software using available aggregate and object templates (analogous to the definition of project aggregates).

The new project assembly template receives a unique project assembly identifier and a plain text name, both of which are inserted into the assembly list. The project-specific assembly list names the standard and project assemblies and object templates used.

The identifier of the project assembly should be based on the identifier of available assemblies and the BACtwin UAK. Due to the project-specific modeling, AMEV1 is omitted as a source and version. Instead of AMEV1, a unique name of the builder's or operator's choice must be specified (e.g. BGP_RHT_NAME1).

In addition, each project assembly must receive a UUID that supports the import and use of the project assembly in databases without naming conflicts.

Type	Trade (Cost Group de 3c ordinal number)	Aggregate/ Assembly/ Plant Template Identifier (de)	Aggregate/ Assembly/ Plant Template Name (en draft)	Referenced Template (de)	Description (de) Prefix: [Location UAK]	Description (de) Examples from UAK Table: [Plant/Room]. [Assembly]. [Medium, Position]	Description (de) Examples from UAK Table: [Aggregate]. [Operating Equipment]. [OE Function]. [OE Function Extension]	Object_Name Example (de)	Trade (Cost Group de)	Plant Abbreviation (de)	Plant Number	Assembly Abbreviation (de)	Assembly Number	Medium, Position (de)	Aggregate Abbreviation (d	Aggregate Number	Operating Equipment Abbr	Operating Equipment Numb	OE Function Abbreviation (	OE Function Number	OE Function Extension	Comment (de)
1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Assembly	330	BGP_MFT_KOM_AME#1	Multifunctional door communication																			
Assembly	410	BGP_SM_AME#1	Fault message individually (e.g. pipe trace heating)																			
Assembly	420	BGP_FWU1_AME#1	District heating transfer < 300 kW according to DIN EN 12828																			
Assembly	420	BGP_FWU2_AME#1	District heating transfer > 300 kW according to DIN EN 12828																			
Assembly	420	BGP_KES_eM_AME#1	Boiler with modulating burner, pump and return lift (e.g. gas)																			
Assembly	420	BGP_GT_KK1_AME#1	Heat source circuit, energetically optimized with valve independent of pressure (e.g. cold water or geothermal energy)																			
Assembly	420	BGP_GT_KK2_AME#1	Heat source circuit, energetically optimized with speed-controlled pump (e.g. cold water or geothermal energy)																			
Assembly	420	BGP_HZ_KU_AME#1	Heat sink circuit (e.g. heating water circuit or recooling circuit)																			
Assembly	420	AGG_WPU_E_AME#1	Heat pump single-stage up to 50kW																			
Assembly	420	AGG_WPU_MOD_AME#1	Heat pump modulating (inverter) up to 50kW																			
Assembly	430	BGP_WRG_ROT_AME#1	Heat recovery with rotary heat exchanger																			
Assembly	430	BGP_WRG_KGS_AME#1	Heat recovery with cross, countercflow heat exchanger																			
Assembly	430	BGP_WRG_KTS_AME#1	Heat recovery system with closed loop system																			
Assembly	430	BGP_VEN3_AME#1	Fan wall (e.g. supply air, 3 fans)																			
Assembly	430	BGP_VRB2_VEK3_AME#1	Fan wall (e.g. supply air, 2 fan assemblies with 3 fans each)																			
Assembly	430	BGP_VEH_AME#1	Preheater																			
Assembly	430	BGP_KHL_AME#1	Cooler																			
Assembly	430	BGP_MEH_AME#1	Reheater																			
Assembly	430	BGP_BEF_UMSP_AME#1	Humidifier (circulating spray humidifier)																			
Assembly	430	BGP_BEF_HDSP_AME#1	Humidifier (High Pressure Spray Humidifier)																			
Assembly	430	BGP_BEF_SB_AME#1	Humidifier wick cooling method (evaporative humidifier, contact humidifier, trickle humidifier)																			
Assembly	430	BGP_BEF_ST_AME#1	Humidifier continuously analogue (evaporative humidifier, contact humidifier, trickle humidifier, hybrid humidifier)																			
Assembly	430	BGP_BEF_EDH_AME#1	Steam humidification with self-steam generator																			
Assembly	430	BGP_BEF_FDH_AME#1	Steam humidification with extraneous steam																			
Assembly	434	BGP_GT_KK1_AME#1	Heat source circuit, energetically optimized with valve independent of pressure (e.g. cold water or geothermal energy)																			
Assembly	434	BGP_GT_KK2_AME#1	Heat source circuit, energetically optimized with speed-controlled pump (e.g. cold water or geothermal energy)																			
Assembly	434	BGP_HZ_KU_AME#1	Heat sink circuit (e.g. heating water circuit or recooling circuit)																			
Assembly	434	BGP_RKW#1_ST_AME#1	Recooling unit dry with no speed-controlled fan(s)																			
Assembly	434	BGP_RKW#2_ST_AME#1	Recooling plant with flow water, several speed-controlled fans																			
Assembly	434	BGP_RKW#3_ST_AME#1	Recooling plant with circulating water, several speed-controlled fans																			
Assembly	434	BGP_ULK_AME#1	Connection cooler with cold water connection or or split unit																			
Assembly	440	BGP_TRF1_AME#1	Transformer (medium voltage, oil insulated)																			
Assembly	440	BGP_TRF2_AME#1	Transformer																			
Assembly	440	BGP_EE6_SB_AME#1	Feed-in management Step-by-step (german EEG)																			
Assembly	440	BGP_EE6_ST_AME#1	Feed-in management infinitely variable (german EEG)																			
Assembly	440	BGP_PVA_AME#1	Photovoltaic system																			
Assembly	440	BGP_MSU_SSM_AME#1	Low Voltage Sub Distribution Collective Fault Message																			
Assembly	440	BGP_MSU_AME#1	Low Voltage Sub Distribution																			
Assembly	440	BGP_USV_AME#1	UPS system (central)																			
Assembly	440	BGP_NEA_AME#1	Emergency power supply system simple																			
Assembly	450	BGP_BMA_AME#1	Fire alarm																			
Assembly	460	BGP_PTA_AME#1	Lift																			
Assembly	460	BGP_RPA_AME#1	Pneumatic tube system																			
Assembly	470	BGP_DIG_AME#1	Digestorium (Sulfur and Chapel)																			
Assembly	470	BGP_CHS_AME#1	Chemical cabinet																			
Assembly	480	BGP_TME_RU_ST_AME#1	Room automation temperature control																			
Assembly	480	BGP_LTA_RU_ST_AME#1	Room automation ventilation																			
Assembly	480	BGP_ABL_RU_ST_AME#1	Room Automation Lighting																			
Assembly	480	BGP_SOM_RU_ST_AME#1	Room automation sun protection																			

Table 13 Assembly template de-en (overview)

2.6 Plant template

A plant template configures a **standard plant** according to the modular principle with the help of standard assemblies, standard aggregates and standard BA functions. A plant template defines a practical minimum set of BA functions for a standard plant (e.g. air conditioning plant). Available best practice solutions are taken into account (e.g. specifications according to [AMEV TMon 2020]).

For the plant template, the appropriate assembly templates and aggregate templates are selected from the BACtwin library and configured into the required plant template using their identifiers. The plant template defines the standard assemblies, standard aggregates and standard BA functions associated with the standard plant and, by means of inheritance, the associated object templates, their properties and parameters.

Each plant template receives a unique identifier, which enables the object properties to be passed on to other information carriers, and a name in plain text.

The plant identifier comprises several parts that are formed from abbreviations based on the UAK and use underscores as separators:

1. **PLT**	type of **template**, three digits	(**PLT** = plant template)
2. **Type**	Abbreviation of the **plant**, three digits	(e.g. **WET**=weather station)
3. **Suffix**	optional, indicates **variants,** one/multi-part	(not applicable in example)
4. **Version**	names the **source and version** of the template	(e.g. **AMEV1**)

Example assembly identifier

Weather station	**PLT_WET_AMEV1**

The following Table 14 shows exemplary plant templates.

In **Library 3**, the plant templates are shown in full in worksheet 10 (see column Type: **Plant**). To distinguish them from the object templates used, the identifiers of the aggregate, assembly and plant templates used are marked in different colors.

Each standard plant has a UUID that supports the import and use of the standard plant in databases without naming conflicts (column C).

In Library 3 the worksheet 10.1 AggTempl de-en contains English translations of the names of the plant templates.

The example templates created for standard plants only cover parts of the required plants. The BA planning must develop the project plants required for the overall function on the basis of BACtwin templates.

A project plant is generated in the planning software using available assembly, aggregate and object templates (analogous to the definition of project assemblies).

The new project asset template receives its own unique project asset identifier and a plain text name, both of which are inserted into the project-specific asset list. The plant list names the standard and project plants, assemblies and object templates used.

The identifier of the project plant should be based on the identifier of available plants and the BACtwin UAK. Due to the project-specific modeling, AMEV1 is omitted as a source and version. Instead of AMEV1, a unique name of the builder's or operator's choice must be specified (e.g. BGP_WET_NAME1).

In addition, each project plant must receive a UUID that supports the import and use of the project plant in databases without naming conflicts.

Type	Trade (Cost Group de as ordinal number)	Aggregate/ Assembly/Plant/ Template Identifier (de)	Aggregate/ Assembly/ Plant Template Name (en draft)	Referenced Template (de)	Description (de) Prefix: [Location UAK]	Description (de) Examples from UAK Table: [Plant/Room], [Assembly], [Medium, Position]	Description (de) Examples from UAK Table: [Aggregate], [Operating Equipment], [OE Function], [OE Function Extension]	Object_Name Example (de)	Trade (Cost Group de)	Plant Abbreviation (de)	Plant Number	Assembly Abbreviation (de)	Assembly Number	Medium, Position (de)	Aggregate Abbreviation (de)	Aggregate Number	Operating Equipment Abbr. (de)	Operating Equipment Number	OE Function Abbreviation (de)	OE Function Number	OE Function Extension
1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Plant	420	AML_2XES_AMEV1	Boiler compound with 2 boilers	SV_AML_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Erzeugungsanlage		*420_EZAxx_#####_###_#####_#####_SV-01	420	EZA	xx	###	##	###	###	##	###	##	SV-	01	
Plant				BI_AM_AMEV1				*420_EZAxx_KES01	420	EZA	xx	EZS	01								
Plant				ADD_ON_AMEV1				*420_EZAxx_KES02	420	EZA	xx	KES	02								
Plant	420	AML_DHA1_AMEV1	Pressure maintenance < 1000 kW (membrane expansion vessel)																		
Plant				SV_AML_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage		*420_DHGxx_#####_###_#####_#####_SV-01	420	DHG	xx	###	##	###	###	##	###	##	SV-	01	
Plant				BI_AM_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Wasseraufbereitung Druck schaltend niedrig Ala	*420_DHGxx_#####_HZR_WMXxx_PSLxx_AM-01	420	DHG	xx	###	##	HZR	WMS	xx	PSL	xx	AM-	01	
Plant	420	AML_DHA2_AMEV1	Pressure maintenance 1000 kW < 4000 kW (pressure maintenance system)																		
Plant				SV_AML_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage		*420_DHGxx_#####_###_#####_#####_SV-01	420	DHG	xx	###	##	###	###	##	###	##	SV-	01	
Plant				BI_BM_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Pumpe Betriebsmeldung	*420_DHGxx_#####_HZR_PPExx_MOTxx_BM-01	420	DHG	xx	###	##	HZR	PPE	xx	MOT	xx	BM-	01	TL
Plant				TL_BM_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Pumpe Betriebsmeldung Datenaufzeichnung	*420_DHGxx_#####_HZR_PPExx_MOTxx_BM-01_TL	420	DHG	xx	###	##	HZR	PPE	xx	MOT	xx	BM-	01	TL
Plant				BI_SA_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Sammelstorung	*420_DHGxx_#####_HZR_#####_#####_SSM01	420	DHG	xx	###	##	HZR	###	##	SSM	01		
Plant				BI_HD_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	LVB Hand	*420_DHGxx_#####_HZR_#####_LVBxx_HD-01	420	DHG	xx	###	##	HZR	LVB	xx	HD-	01		
Plant				AI_PW_P_Tem_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Druck Messwert Datenaufzeichung	*420_DHGxx_#####_HZR_EF=xx_P=xx_PW-01	420	DHG	xx	###	##	HZR	EF=	xx	P=x	xx	PW-	01	TL
Plant				TL_AN_P_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Druck Messwert Datenaufzeichnung	*420_DHGxx_#####_HZR_EF=xx_P=xx_PW-01_TL	420	DHG	xx	###	##	HZR	EF=	xx	P=x	xx	PW-	01	TL
Plant				AU_ZW_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Wasserzähler Menge Zahlwert	*420_DHGxx_#####_HZR_WMZxx_F=xx_ZW-01	420	DHG	xx	###	##	HZR	WMZ	xx	F=x	xx	ZW-	01	TL
Plant				TL_AU_P_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Wasserzähler Menge Zahlwert Datenaufzeichnung	*420_DHGxx_#####_HZR_WMZxx_F=xx_ZW-01_TL	420	DHG	xx	###	##	HZR	WMZ	xx	F=x	xx	ZW-	01	TL
Plant				BI_SM_AMEV1	[Ortskenz]	Warmeversorgungsanlagen Druckhaltungsanlage Heizwasser	Wasserzähler Menge Störmeldung	*420_DHGxx_#####_HZR_WMZxx_F=xx_SM-01	420	DHG	xx	###	##	HZR	WMZ	xx	F=x	xx	SM-	01	
Plant	430	AML_WRG_KVS_AMEV1	Cross-plant heat recovery system with closed-loop system as an intermediate circuit																		
Plant				SV_AML_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück		*430_KVSxx_WRGxx_###_#####_#####_SV-01	430	KVS	xx	WRG	xx	###	##	###	###	##	SV-	01	
Plant				ADD_SPE_01_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Speicherladeregelung Umlaufwasser-Rücklauf		430	KVS	xx	WRG	xx	WAR	PVE	xx					
Plant				ADD_WTR_ST1_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Speicherladeregelung Umlaufwasser-Rücklauf		430	KVS	xx	WRG	xx	WAR	VEN	xx					
Plant				AI_MW_T_L_RU_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert	*430_KVSxx_WRGxx_WAR_EF=xx_T=xx_MW-01	430	KVS	xx	WRG	xx	WAR	EF=	xx	T=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert Datenaufzeichnung	*430_KVSxx_WRGxx_WAR_EF=xx_T=xx_MW-01_TL	430	KVS	xx	WRG	xx	WAR	EF=	xx	T=x	xx	MW-	01	TL
Plant				AI_MW_T_L_RU_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert	*430_KVSxx_WRGxx_UWV_EF=xx_T=xx_MW-01	430	KVS	xx	WRG	xx	UWV	EF=	xx	T=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert Datenaufzeichnung	*430_KVSxx_WRGxx_UWV_EF=xx_T=xx_MW-01_TL	430	KVS	xx	WRG	xx	UWV	EF=	xx	T=x	xx	MW-	01	TL
Plant				AI_MW_T_L_RU_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert	*430_KVSxx_WRGxx_AU-_EF=xx_T=xx_MW-01	430	KVS	xx	WRG	xx	AU-_	EF=	xx	T=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert Datenaufzeichnung	*430_KVSxx_WRGxx_AU-_EF=xx_T=xx_MW-01_TL	430	KVS	xx	WRG	xx	AU-_	EF=	xx	T=x	xx	MW-	01	TL
Plant				AI_MW_T_L_RU_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert	*430_KVSxx_WRGxx_ZU-_EF=xx_T=xx_MW-01	430	KVS	xx	WRG	xx	ZU-_	EF=	xx	T=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert Datenaufzeichnung	*430_KVSxx_WRGxx_ZU-_EF=xx_T=xx_MW-01_TL	430	KVS	xx	WRG	xx	ZU-_	EF=	xx	T=x	xx	MW-	01	TL
Plant				AI_MW_T_L_RU_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert	*430_KVSxx_WRGxx_FO-_EF=xx_T=xx_MW-01	430	KVS	xx	WRG	xx	FO-_	EF=	xx	T=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Temperatur Messwert Datenaufzeichnung	*430_KVSxx_WRGxx_FO-_EF=xx_T=xx_MW-01_TL	430	KVS	xx	WRG	xx	FO-_	EF=	xx	T=x	xx	MW-	01	TL
Plant				AI_MWC_DW2_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Wirkungsgrad Messwert berechnet	*430_KVSxx_WRGxx_###_#####_DWZxx_MWC01	430	KVS	xx	WRG	xx	###	###	##	DWZ	xx	MWC	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Luftechnische Anlagen Kreislaufverbundsystem Warmerück	Wirkungsgrad Messwert berechnet Datenaufzeichnun	*430_KVSxx_WRGxx_###_#####_DWZxx_MWC01_TL	430	KVS	xx	WRG	xx	###	###	##	DWZ	xx	MWC	01	TL
Plant	430	AML_ABA_SSL_AMEV1	Exhaust air system, (airflow monitored)																		
Plant				SV_AML_AMEV1	[Ortskenz]	Luftechnische Anlagen Abluftanlage Ventilatorhaupt		*430_ABAxx_V00xx_AB-_#####_#####_SV-01	430	ABA	xx	VEN	xx	AB-_	###	##	SV-	01		
Plant				ADD_VSER_E_AMEV1					430	ABA	xx	VER	xx	AB-_							
Plant				BI_GM_AMEV1	[Ortskenz]	Luftechnische Anlagen Abluftanlage Ventilatorhauptgrupp	Leitstromüberwachung Gefahrmeldung	*430_ABAxx_V00xx_AB-_EF=xx_SSL=x_GM-01	430	ABA	xx	VEN	xx	AB-_	EF=	xx	SSL	xx	GM-	01	
Plant	440	AML_YBAx_SBLx_AMEV1	Emergency lighting																		
Plant				SV_AML_AMEV1	[Ortskenz]	Starkstromanlagen Verbrauchsanlage Sicherheitsbeleuchtu		*440_YBAxx_SBLxx_###_#####_#####_SV-01	440	YBA	xx	SBL	xx	###	###	##	SV-	01		
Plant				BI_BB_AMEV1	[Ortskenz]	Starkstromanlagen Verbrauchsanlage Sicherheitsbeleuchtu	Betriebsbereit	*440_YBAxx_SBLxx_###_#####_#####_BB-01	440	YBA	xx	SBL	xx	###	###	##	BB-	01		
Plant				BI_SM_AMEV1	[Ortskenz]	Starkstromanlagen Verbrauchsanlage Sicherheitsbeleuchtu	Sammelstorung	*440_YBAxx_SBLxx_###_#####_#####_SSM01	440	YBA	xx	SBL	xx	###	###	##	SSM	01		
Plant				BI_AM_AMEV1	[Ortskenz]	Starkstromanlagen Verbrauchsanlage Sicherheitsbeleuchtu	Alarmmeldung	*440_YBAxx_SBLxx_###_#####_#####_AM-01	440	YBA	xx	SBL	xx	###	###	##	AM-	01		
Plant	480	AGG_AET_AMEV1	Weather station communication																		
Plant				SV_AML_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene		*480_WETxx_GBGxx_###_#####_#####_SV-01	480	WET	xx	GBG	xx	###	###	##	SV-	01		
Plant				BV_SN_MAF_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Störmeldung	*480_WETxx_GBGxx_DA-_#####_FEExx_SN-01	480	WET	xx	GBG	xx	DA-_	###	##	FEE	xx	SN-	01		
Plant				AI_MW_WIG_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Windgeschwindigkeit Messwert	*480_WETxx_GBGxx_DA-_MFExx_WIGxx_MW-01	480	WET	xx	GBG	xx	DA-_	MFE	xx	WIG	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Windgeschwindigkeit Messwert Datenaufzeichnung	*480_WETxx_GBGxx_DA-_MFExx_WIGxx_MW-01_TL	480	WET	xx	GBG	xx	DA-_	MFE	xx	WIG	xx	MW-	01	TL
Plant				AI_MW_WIR_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Windrichtung Messwert	*480_WETxx_GBGxx_DA-_MFExx_WIRxx_MW-01	480	WET	xx	GBG	xx	DA-_	MFE	xx	WIR	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Windrichtung Messwert Datenaufzeichnung	*480_WETxx_GBGxx_DA-_MFExx_WIRxx_MW-01_TL	480	WET	xx	GBG	xx	DA-_	MFE	xx	WIR	xx	MW-	01	TL
Plant				AV_MW_E_AU_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert Datenaufzeichnung	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01_TL	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	TL
Plant				AV_MW_E_AU_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert	*480_WETxx_GBGxx_C00_MFExx_E=xx_MW-01	480	WET	xx	GBG	xx	C00_	MFE	xx	E=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert Datenaufzeichnung	*480_WETxx_GBGxx_C00_MFExx_E=xx_MW-01_TL	480	WET	xx	GBG	xx	C00_	MFE	xx	E=x	xx	MW-	01	TL
Plant				AV_MW_E_AU_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert Datenaufzeichnung	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01_TL	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	TL
Plant				AV_MW_E_AU_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert Datenaufzeichnung	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01_TL	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	TL
Plant				AV_MW_E_AU_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene F	Beleuchtungsstärke Messwert Datenaufzeichnung	*480_WETxx_GBGxx_A00_MFExx_E=xx_MW-01_TL	480	WET	xx	GBG	xx	A00_	MFE	xx	E=x	xx	MW-	01	TL
Plant				AV_MW_E_AU_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene A	Beleuchtungsstärke Messwert	*480_WETxx_GBGxx_AU-_MFExx_E=xx_MW-01	480	WET	xx	GBG	xx	AU-_	MFE	xx	E=x	xx	MW-	01	
Plant				TL_AU_P_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene A	Beleuchtungsstärke Messwert Datenaufzeichnung	*480_WETxx_GBGxx_AU-_MFExx_E=xx_MW-01_TL	480	WET	xx	GBG	xx	AU-_	MFE	xx	E=x	xx	MW-	01	TL
Plant				AV_MH_DA_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Feuchtwächter hoch Rückmeldung	*480_WETxx_GBGxx_DA-_MFExx_MSHxx_MH-01	480	WET	xx	GBG	xx	DA-_	MFE	xx	MSH	xx	MH-	01	
Plant				TL_BH_AMEV1	[Ortskenz]	Gebäudeautomationssysteme Wetterstation Baugruppenebene D	Feuchtwächter hoch Rückmeldung Datenaufzeichnu	*480_WETxx_GBGxx_DA-_MFExx_MSHxx_MH-01_TL	480	WET	xx	GBG	xx	DA-_	MFE	xx	MSH	xx	MH-	01	TL

Table 14 Plant template (example)

2.7 Responsibility table, BACtwin table

The tables and lists of properties require careful consideration due to the high number, complexity and different meanings of the properties.

In object templates, the properties and parameters recommended for a BACnet object are defined in an object-specific table form. A **cross-object table form** is required to define the responsibilities for properties. The cross-object table form is also used for BACtwin tables and project lists.

If the properties are presented in alphabetical order, the factual context necessary for human understanding is missing. Meaningful priorities cannot be identified with this arrangement (e.g. Object_Name and Description do not appear together and do not appear first). When sorted alphabetically or numerically, the responsibilities for properties cannot be represented in a meaningful context.

In order to make it easier for users to understand and control the properties, the properties to be parameterized are arranged in a context-oriented manner in cross-object property tables (analogous to BACS-FL). The properties are first assigned to a **functional area** (Table 15).

ID Property	Functional area	ID Object type
a	Addressing	**---**
b	Data Sharing	**B**
c	Alarm and Event Management	**C**
d	Trending	**D**
e	Scheduling	**E**
f	Loop	**F**
g - w	not used (reserve for expansions)	**G - W**
x	Structure	**X**
y	Device and Network Management	**Y**

Table 15 Functional area

In the second step, **responsibility for properties** is classified. Table 16 indicates in the left column the responsibility for the parameterization of properties with code letters:
B (builder, operator), **P** (planning) and **X** (executing company).
In the right column, each area of responsibility is assigned its own number block. The middle column contains typical application examples for properties.

ID Responsibility	Area of responsibility (examples)	Number pad
B = Builder, operator	Addressing, description, priority, status text, set-point, switching time, calendar, at least BACnet protocol revision	**B = 11 - 39**
P = BAC planning	Installation location, limit value, physical unit, default value, recording interval, controller type	**P = 41 - 69**

X = Executing company	Object instance, vendor information, software information, network setting	**X = 71 - 99**

Table 16 Area of responsibility

In order to automate the context-oriented arrangement, each property receives a three-digit alphanumeric identifier called **PropSort**.

The first position of PropSort indicates the functional area of the property with a lowercase letter for the functional area (Table 16, left column).

Two numbers in the 2nd and 3rd positions of PropSort indicate the responsibility for the property using the right column in Table 17, which provides a block of numbers for each area of responsibility. By choosing the number, the order of the property in the functional area is also determined.

Example PropSort
The **Object_Name** property belongs to the functional area a = addressing (1st digit = a). The responsibility for Object_Name lies with the client or operator (i.e. area of responsibility A = number block 11 - 39). Within the number block, Object_Name is particularly important and therefore takes first place (2nd and 3rd digits = 11).

As a result, the **PropSort** for the **Object_Name** property is: **a11**.

Analogous to the three-digit identifier PropSort, the two-digit identifier **ObjSort** enables context-oriented sorting of **objects**. A capital letter indicates the functional area of the object type (Table 16, right column). An additional number defines the order of the object template within the respective functional area.

An example of a context-oriented property table is shown in the **responsibility table**.

The responsibility table (Table 17) presents the properties of the AMEV profile AS-D to be parameterized in a compact form (on 1 page DIN A4) in a context-oriented manner. Using code letters (B/P/X), it names the responsibilities for parameterization specifications of the properties. The PropSort identifier is used for the vertical sorting of the properties and the ObjSort identifier is used for the horizontal sorting of the object types.

The **library 2** contains the responsibility table as work sheet **17 ZuständTab**.

Another example of the context-oriented representation of properties is shown below in the **BACtwin table** (example – excerpt).

The BACtwin table (Table 18) lists the standard aggregates vertically and the properties of the AMEV profile AS-D that need to be parameterized horizontally. For contextual horizontal sorting of properties, the identifier PropSort is used. The entries of parameter values are marked in yellow.

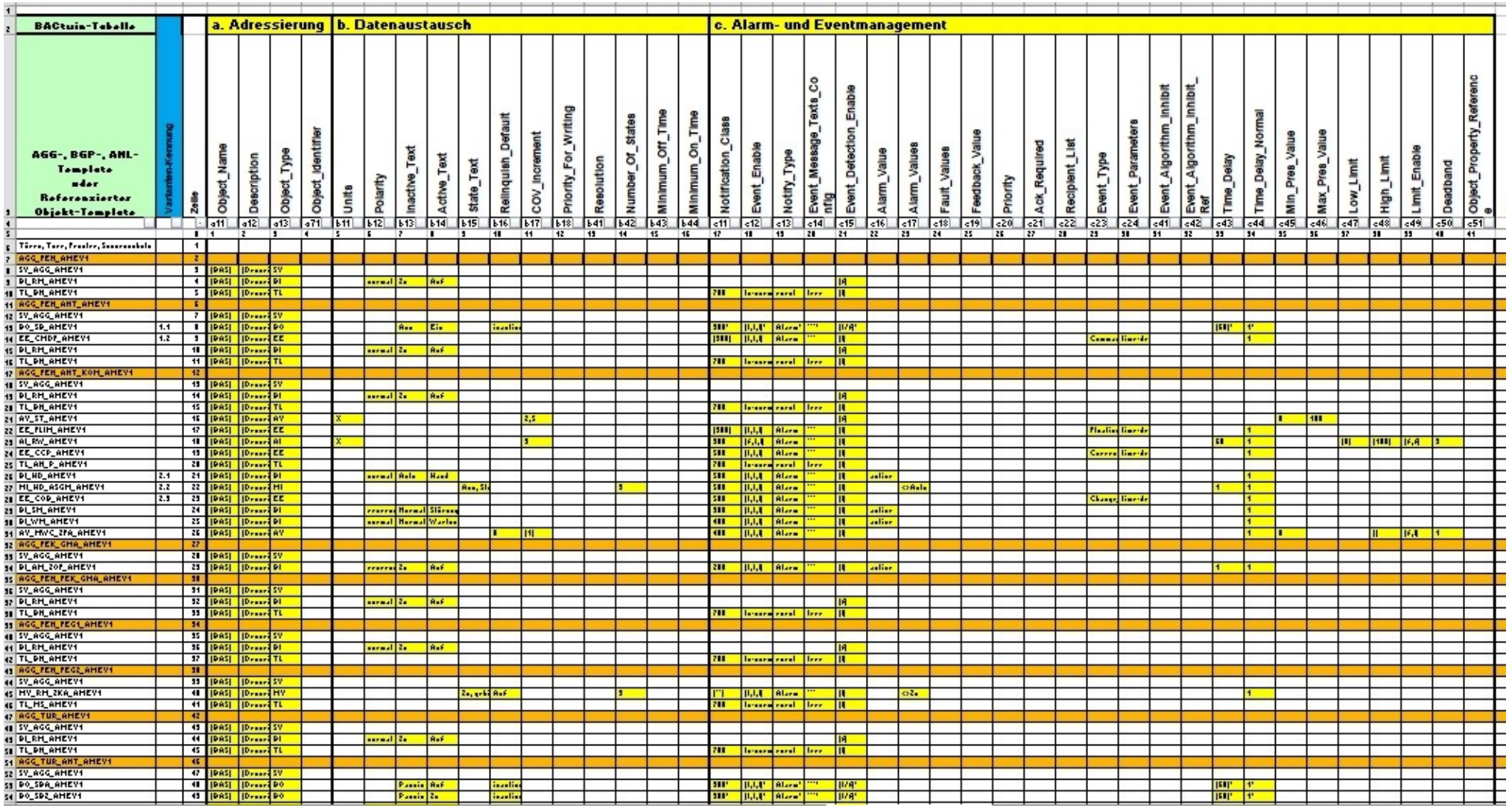
The BACtwin table can be used for the documentation of BACtwin lists in project libraries and for the data exchange of BACtwin lists.

The **library 3** contains the BACtwin table as work sheet **18 BACtwinTab**.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Nr ges.	Nr Ber.	Fkt.Bereich Name	Property	Prop Sort	Zust *	b1 AI	b2 AO	b3 AV	b4 BI	b5 BO	b6 BV	b7 MI	b8 MO	b9 MV	c1 NC	c2 EE	d1 TL	e1 CAL	e2 SCH	f1 LP	x1 SV	y1 DEV	y2 FIL
1	1	a. Adressierung	Object_Name	a11	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
2	2		Description	a12	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
3	3		Object_Type	a13	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
4	4		Object_Identifier	a71	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
5	1	b. Daten-austausch	Units	b11	B	B	B	B															
6	2		Polarity	b12	B				B	B													
7	3		Inactive_Text	b13	B				B	B	B												
8	4		Active_Text	b14	B				B	B	B												
9	5		State_Text	b15	B							B	B	B									
10	6		Relinquish_Default	b16	B		B	B		B	B		B	B									
11	7		COV_Increment	b17	B	B	B	B												B			
12	8		Priority_For_Writing	b18	B														B	B			
13	9		Resolution	b41	P	P	P																
14	10		Number_Of_States	b42	P							P	P	P									
15	11		Minimum_Off_Time	b43	P					P	P												
16	12		Minimum_On_Time	b44	P					P	P												
17	1	c. Alarm- und Event-management	Notification_Class	c11	B	B	B	B	B	B	B	B	B	B	B	B	B		B				
18	2		Event_Enable	c12	B	B	B	B	B	B	B	B	B	B		B	B		B				
19	3		Notify_Type	c13	B	B	B	B	B	B	B	B	B	B		B	B		B				
20	4		Event_Message_Texts_Config	c14	B	B	B	B	B	B	B	B	B	B		B	B		B				
21	5		Event_Detection_Enable	c15	B	B	B	B	B	B	B	B	B	B		B	B		B				
22	6		Alarm_Value	c16	B				B		B												
23	7		Alarm_Values	c17	B							B		B									
24	8		Fault_Values	c18	B							B		B									
25	9		Feedback_Value	c19	B					B			B										
26	10		Priority	c20	B										B								
27	11		Ack_Required	c21	B										B								
28	12		Recipient_List	c22	B										B								
29	13		Event_Type	c23	B											B							
30	14		Event_Parameters	c24	B											B							
31	15		Event_Algorithm_Inhibit	c41	P	P	P	P	P	P	P	P	P	P		P							
32	16		Event_Algorithm_Inhibit_Ref	c42	P	P	P	P	P	P	P	P	P	P		P							
33	17		Time_Delay	c43	P	P	P	P	P	P	P	P	P	P						P			
34	18		Time_Delay_Normal	c44	P	P	P	P	P	P	P	P	P	P		P				P			
35	19		Min_Pres_Value	c45	P	P	P	P															
36	20		Max_Pres_Value	c46	P	P	P	P															
37	21		Low_Limit	c47	P	P	P	P															
38	22		High_Limit	c48	P	P	P	P															
39	23		Limit_Enable	c49	P	P	P	P															
40	24		Deadband	c50	P	P	P	P												U			
41	25		Object_Property_Reference	c51	P											P							
42	1	d. Trendauf-zeichnung	Enable	d11	B												B						
43	2		Log_DeviceObjectProperty	d12	B												B						
44	3		Log_Interval	d13	B												B						
45	4		COV_Resubscription_Interval	d14	B												B						
46	5		Client_COV_Increment	d15	B												B						
47	6		Stop_When_Full	d16	B												B						
48	7		Buffer_Size	d17	B												B						
49	8		Logging_Type	d18	B												B						
50	9		Trigger	d19	B												B						
51	10		Notification_Threshold	d20	B												B						
52	1	e. Zeit-management	Date_List	e11	B													B					
53	2		Effective_Period	e12	B														B				
54	3		Weekly_Schedule	e13	B														B				
55	4		Exception_Schedule	e14	B														B				
56	5		Schedule_Default	e15	B														B				
57	6		List_Of_Object_Property_Reference	e71	P														P				
58	1	f. Regler	Setpoint_Reference	f11	B															B			
59	2		Action	f41	P															P			
60	3		Controlled_Variable_Reference	f42	P															P			
61	4		Controlled_Variable_Units	f43	P															P			
62	5		Minimum_Output	f44	P															P			
63	6		Maximum_Output	f45	P															P			
64	7		Manipulated_Variable_Reference	f46	P															P			
65	8		Output_Units	f47	P															P			
66	9		Proportional_Constant	f71	U															U			
67	10		Proportional_Constant_Units	f72	U															U			
68	11		Derivative_Constant	f73	U															U			
69	12		Derivative_Constant_Units	f74	U															U			
70	13		Integral_Constant	f75	U															U			
71	14		Integral_Constant_Units	f76	U															U			
72	1	x. Struktur	Node_Type	x11	B																B		
73	2		Node_Subtype	x12	B																B		
74	3		Subordinate_List	x13	B																B		
75	1	y. Geräte- und Netzwerk-Management	Location	y11	B																	B	
76	2		Protocol_Version	y12	B																	B	
77	3		Protocol_Revision	y13	B																	B	
78	4		Protocol_Services_Supported	y14	B																	B	
79	5		Protocol_Object_Types_Supported	y15	B																	B	
80	6		UTC_Offset	y16	B																	B	
81	7		UTC_Time_Synchronization_Recipients	y17	B																	B	
82	8		Time_Synchronization_Recipients	y18	B																	B	
83	9		Time_Synchronization_Interval	y19	B																	B	
84	10		Align_Intervals	y20	B																	B	
85	11		Interval_Offset	y21	B																	B	
86	12		Max_Master	y22	B																	B	
87	13		Max_Info_Frames	y23	B																	B	

*** Zuständig:** B = Bauherr/Betreiber (grün) | P = Planung (gelb) | U = Ausführendes Unternehmen (blau)

Table 17 Responsibility table



| BACtwin-Tabelle | Varianten-Kennung | Zeile | a. Adressierung | | | | b. Datenaustausch | | | | | | | | | | | | c. Alarm- und Eventmanagement | | | | | | | | | | | |

Table 18 BACtwin table (example – excerpt)

2.8 Object type Structured View (SV)

Automation stations with the AMEV profile AS-D have SV objects that can be used to automatically check the BA mass data, display the plant structures transparently and simplifiy the dynamization of graphics in the MOU. The use of the Structured_View object type is explained below.

Each template for a plant, assembly or aggregate is equipped with an SV object. Essential information about the templates used is stored in these SV objects. This information can be used for automated checks of planned and used templates. The implementation of the SV objects makes automated checks easier.

In addition, the respective plant structures are automatically derived from the information. The data contents of the respective aggregates, assemblies and plant templates are displayed in a logical tree structure.

An example of an automatically created plant structure is shown in Figure 7:

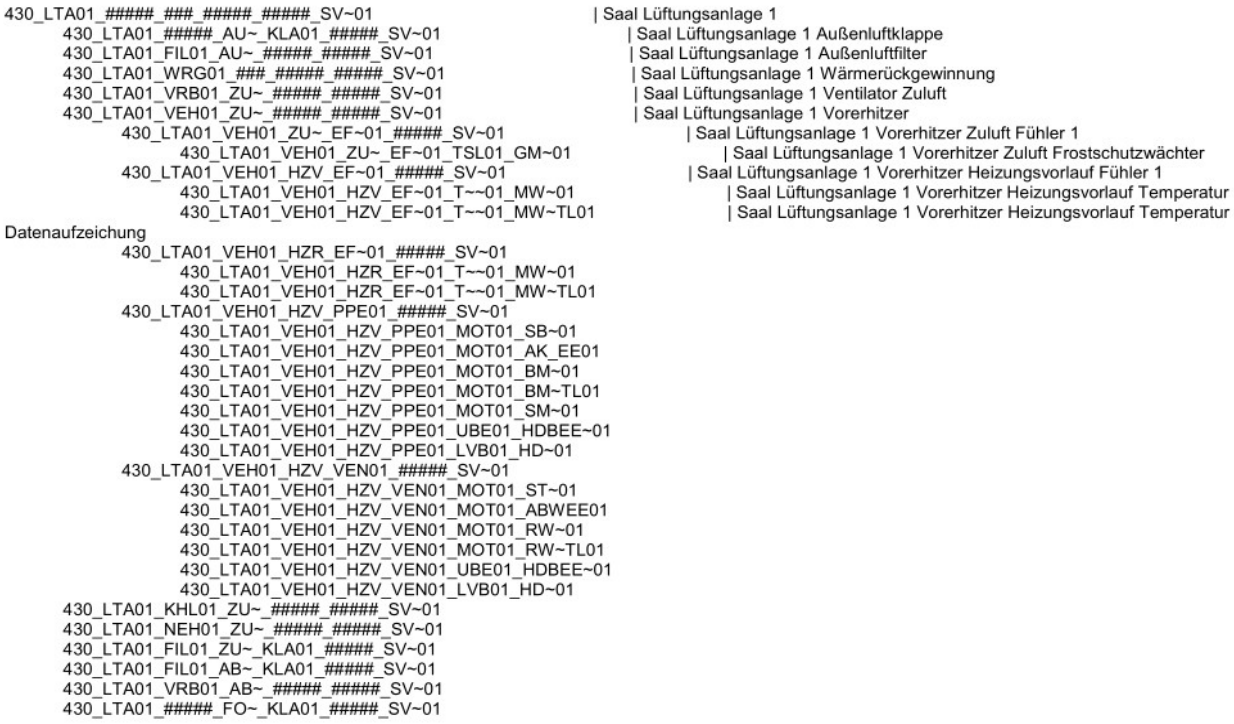


Figure 7 Automatically created plant structure (example: ventilation plant)

In real plant operation, the Object_Identifier is used to address the BACnet objects (Addressing by number). Since the Object_Identifier are only defined in the configuration (the Object_Identifier is therefore not available in planning tools and in the XML exchange format), BACtwin uses the Object_Name (Addressing by name), i.e. the UAK, in the planning phase.

In contrast to the other BACnet objects, the UAK shown in the Object_Name of the SV object is limited to the plant level (the UAK parts assembly and aggregate only contain padding characters), the assembly level (the UAK portion contains aggregate only fill characters) or the respective aggregate level.

The description of the SV object describes the template (e.g. aggregate: pump; assembly: preheater; plant: weather station) and can be displayed in the visualization.

Each SV object only contains a list of objects (array) that it references. In order to map the plant structure, it only references one level, the one directly below it.

The **Node_Type** property is used for the machine-interpretable assignment to the plant, assembly or aggregate level. For every plant, assembly and every aggregate, the appropriate permissible term is set up in the property Node_Type of the SV object (BACnet standard [DIN EN ISO 16484-5] see 12. 29. 5):

- Aggregate Node_Type = EQUIPMENT
- Module Node_Type = SUBSYSTEM
- Facility Node_Type = SYSTEM

In the **Node_Subtype** property, the aggregate template identifier from the library 3 is set up for a standard aggregate.
Example: AGG_PMP_S1_AMEV1

The modified identifier of the project aggregate is set up for a project aggregate (= project-specific modified aggregate template) in the Node_Subtype property.
Example: AGG_PMP_S1_NAME1

In addition, the object identifiers contained in the object template are specified as an array in the **Subordinate_List** property of each SV object.

The object templates of the SV objects are defined in Library 2 in worksheet 8.13.

As an example, Figure 8 below shows a heating circuit and Figure 9 an overview of the BACnet objects associated with this heating circuit, including the SV objects with the properties Node_Type, Node_Subtype and Subordinate_List.

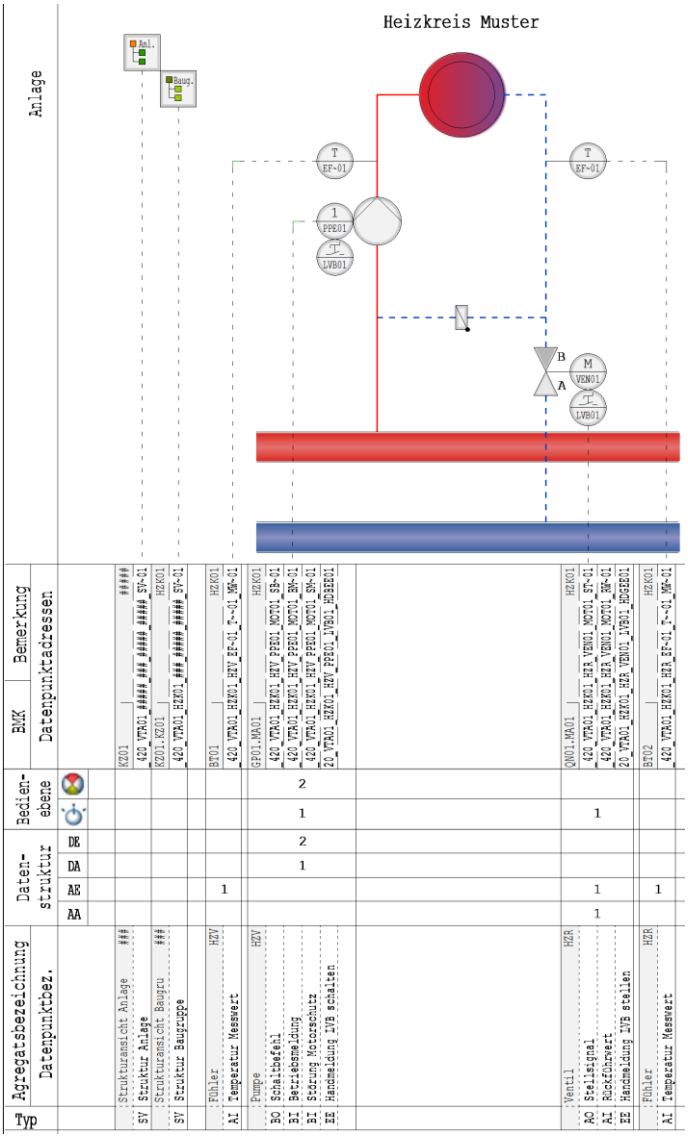


Figure 8 Example Heating circuit – graphic representation

Identifier*	Object Name	Description	Wert	Node_Type	Node_Subtype	Subordinate_List
999.SV0	ORTS-BAS_420_VTAxx_#####_###_#####_#####_SV~01	Verteilanlage xx		SYSTEM		[999.SV1]
999.SV1	ORTS-BAS_420_VTAxx_HZKxx_###_#####_#####_SV~01	Verteilanlage xx Heizkreis xx		SUBSYSTEM		[999.SV2,999.SV3,999.SV4,999.SV5]
999.SV2	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_#####_SV~01	Verteilanlage xx Heizkreis xx Pumpe 1		EQUIPMENT	AGG_PPE_E1_AMEV1	[999.BO0,999.EV0,999.BI0,999.TL0,999.BI1, 999.BI3,999.EV1,999.EV2]
999.BO0	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_PPE01_SB~01	Verteilanlage xx Heizkreis xx Pumpe 1 Schaltbefehl	Ein			
999.EV0	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_MOT01_AK~EE01	Verteilanlage xx Heizkreis xx Pumpe 1 Ausführkontrolle	Normal			
999.BI0	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_MOT01_BM~01	Verteilanlage xx Heizkreis xx Pumpe 1 Betriebsmeldung	Ein			
999.TL0	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_MOT01_BM~TL01	Verteilanlage xx Heizkreis xx Pumpe 1 Betriebsmeldung Datenaufzeichnung	Aufzeichnung			
999.BI1	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_MOT01_SM~01	Verteilanlage xx Heizkreis xx Pumpe 1 Störmeldung	Normal			
999.BI3	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_LVB01_HD~01	Verteilanlage xx Heizkreis xx Pumpe 1 Pumpe LVB Hand	Auto			
999.EV2	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_LVB01_HD~EE01	Verteilanlage xx Heizkreis xx Pumpe 1 Handmeldung LVB	Normal			
999.EV1	ORTS-BAS_420_VTAxx_HZKxx_HZV_PPE01_UBE01_HD~EE01	Verteilanlage xx Heizkreis xx Pumpe 1 Handmeldung UBE	Normal			
999.SV3	ORTS-BAS_420_VTAxx_HZKxx_HZV_VEN01_#####_SV~01	Verteilanlage xx Heizkreis xx Ventil 1		EQUIPMENT	AGG_VEN_ST_AMEV1	[999.AI1,999.EV3,999.AI1,999.TL2,999.EV4,999.EV5]
999.AI1	ORTS-BAS_420_VTAxx_HZKxx_HZV_VEN01_MOT01_ST~01	Verteilanlage xx Heizkreis xx Ventil 1 Stellsignal	12,1%			
999.EV3	ORTS-BAS_420_VTAxx_HZKxx_HZR_VEN01_MOT01_ABWEE01	Verteilanlage xx Heizkreis xx Ventil 1 Abweichung	Normal			
999.AI1	ORTS-BAS_420_VTAxx_HZKxx_HZV_VEN01_MOT01_RW~01	Verteilanlage xx Heizkreis xx Ventil 1 Rückführwert	11,8%			
999.TL2	ORTS-BAS_420_VTAxx_HZKxx_HZR_VEN01_MOT01_RW~TL01	Verteilanlage xx Heizkreis xx Ventil 1 Rückführwert Datenaufzeichnung	Aufzeichnung			
999.EV4	ORTS-BAS_420_VTAxx_HZKxx_HZR_VEN01_UBE01_HD~EE01	Verteilanlage xx Heizkreis xx Ventil 1 Handmeldung UBE	Normal			
999.EV5	ORTS-BAS_420_VTAxx_HZKxx_HZR_VEN01_LVB01_HD~EE01	Verteilanlage xx Heizkreis xx Ventil 1 Handmeldung LVB	Normal			
999.SV4	ORTS-BAS_420_VTAxx_HZKxx_HZV_EF~01_T~01_SV~01	Verteilanlage xx Heizkreis xx Vorlauf Temperaturfühler 1		EQUIPMENT	AGG_EF_NT_T_AMEV1	[999.AI0,999.TL1]
999.AI0	ORTS-BAS_420_VTAxx_HZKxx_HZV_EF~01_T~01_MW~01	Verteilanlage xx Heizkreis xx Vorlauf Temperatur 1 Messwert	42 °C			
999.TL1	ORTS-BAS_420_VTAxx_HZKxx_HZV_EF~01_T~01_MW~TL01	Verteilanlage xx Heizkreis xx Vorlauf Temperatur 1 Messwert Datenaufzeichnung	Aufzeichnung			
999.SV5	ORTS-BAS_420_VTAxx_HZKxx_HZR_EF~01_T~01_SV~01	Verteilanlage xx Heizkreis xx Rücklauf Temperaturfühler 1		EQUIPMENT	AGG_EF_NT_T_AMEV1	[999.AI3,999.TL3]
999.AI3	ORTS-BAS_420_VTAxx_HZKxx_HZR_EF~01_T~01_MW~01	Verteilanlage xx Heizkreis xx Rücklauf Temperatur 1 Messwert	28 °C			
999.TL3	ORTS-BAS_420_VTAxx_HZKxx_HZR_EF~01_T~01_MW~TL01	Verteilanlage xx Heizkreis xx Rücklauf Temperatur 1 Messwert Datenaufzeichnung	Aufzeichnung			

Figure 9 Example Heating circuit – Overview of objects and SV properties

3 BACtwin-capable SW tools and data exchange

3.1 BACtwin-capable planning tool

BACtwin-capable planning tools are an important prerequisite for exploiting the high potential that the BACtwin concept offers for simplification, error prevention and quality improvement in BACnet projects.

Software manufacturers are recommended to import the BACtwin library templates into their planning tools.

A BACtwin-capable planning tool should enable the handling of the data and functions listed in Table 19. Handling includes importing/entering, editing, saving and exporting in lines 1, 3, 5 - 11, 14, 17 and 18.

1.	BACtwin libraries and project data
2.	Planning documents (plant lists, diagrams, functional descriptions) can be created from available templates.
3.	Standardized BACnet objects and properties
4.	Indication of the supported BACnet revision (at least Rev. 12, recommended Rev. 16).
5.	BACnet profiles according to AMEV BACtwin
6.	Project-specific BACtwin library (schema, description, BA function list)
7.	Templates (OBJ, AGG, BGP, ANL) as project templates
8.	BACtwin lists (OBJ, AGG, BGP, ANL)
9.	BACtwin lists (OBJ, AGG, BGP, ANL) can be named.
10.	BACtwin UAK as a template for Object_Name/Description
11.	User-specific UAK as a template for Object_Name/Description
12.	Properties Object_Name can be generated automatically from UAK template.
13.	Properties description can be generated automatically from UAK template.
14.	Properties Description as a template
15.	Use of the BACnet and AMEV terms, AMEV can be switched between German and English.
16.	Project library (project-specific lists) can be displayed.
17.	Project library (analogous to BACtwin library)
18.	Project data (at least BACS function lists, BACS function descriptions, BACS automation schemes, BACtwin lists)

Table 19 BACtwin-capable planning tool

3.2 BACtwin-capable engineering tool

BACtwin-capable engineering tools are also an essential prerequisite for exploiting the high potential that the BACtwin concept offers for simplification, error prevention and quality improvement in BACnet projects.

BACnet manufacturers are recommended to import the BACtwin library templates into their engineering tools.

A BACtwin-capable engineering tool should enable the data and functions listed in Tables 19 and 20 to be handled. Handling includes importing/entering, editing, saving and exporting in Table 20 line 19.

1. - 18.	Handling of data and functions according to Table 20 No. 1 to 18.
19.	Implementation documents (at least BA function lists, BA function descriptions, BA automation schemes, BACtwin lists)
20.	All BACnet objects and properties used can be switched visibly.
21.	Reverse engineering (optional).

Table 20 BACtwin-capable engineering tool

3.3 BACtwin-capable scan tool

When using the model-based BACtwin concept, the BACnet systems and project data should be automatically checked for compliance with the specifications and consistency. A scan tool carries out a comprehensive inventory and visualization of the BACnet project data in automation stations.

A BACtwin-capable scan tool should meet the requirements of Table 21:

1.	Scan and read BACnet devices: display objects used, properties, parameters.
2.	Export used objects, properties, parameters.
3.	Display and export used objects and properties for selected functional areas as BACtwin lists.
4.	Data exchange formats XLSX/CSV, XML/JSON

Table 21 BACtwin-capable scan tool

3.4 BACtwin-capable test tool

A test tool check:

a) the BACtwin planning against the operator requirement,
b) the automation stations against the BACtwin project data from the planning.

A BACtwin-capable test tool should meet the requirements of Table 22:

1.	Import/enter BACtwin library (including operator requirement).
2.	Read in BA planning data.
3.	Read BA execution data.
4.	Compare a) the data from lines 2 with 1., present comparison results, comment and save.
5.	Compare b) the data from lines 3 with 2., present comparison results, comment and save.
6.	Exporting the comparison results a) and b) in XLSX/CSV, JSON/XML, HTML and PDF

Table 22 BACtwin-capable test tool

The functions of the BACtwin-capable scan tool (Table 21) and BACtwin-capable test tool (Table 22) can be combined in one program.

3.5 BACtwin-capable data exchange

The standardized BACtwin data enables important analyzes and optimizations that improve the reliability, cost-effectiveness and sustainability of the BA systems. The BACtwin data model forms the database for the use of corresponding SW tools. When using the SW tools, automated import and export processes are helpful and recommended.

The BACtwin-capable data exchange serves the following purposes:

- Support integration of the BACtwin data model into BACtwin-enabled tools.
- Support the exchange of BIM information in/to BACtwin-enabled planning tools.
- Exchange of the results of BACnet planning in a machine-interpretable, 1:1 verifiable form.
- Transfer of planning results to BACtwin-capable engineering and testing tools.
- Export of the BACnet engineering results in a 1:1 verifiable form.
- Export of test results from test tools for target/actual comparisons and acceptance.
- Import of planning results into simulation software for functional analysis.
- Support transfer of data records from the BA system for TMon analysis and operational optimization [AMEV TMon 2020].
- Export of operating data from the MOU for operational monitoring (e.g. aggregate addresses, message texts, trend recordings, meter readings).
- Export of operating data from the BA system for sustainability reports (e.g. ESG reporting), CAFM analyses, (BIM) space management and energy data management in existing buildings and new buildings [AMEV Energy and Costs in competitions 2014].

Lossless data exchange must be ensured during the import and export processes described above. In order to avoid media disruptions, loss of information, double work, etc., it is essential to use **uniform data exchange formats**.

So that BACtwin systems can be implemented with as little work as possible and optimal work quality, the following is recommended:

The tables and templates of the BACtwin library are created in **XLSX** data format.

BACtwin-capable SW tools should be able to import the tables from the BACtwin libraries. To enable further editing, the planning tools must be able to export BA planning data as BACtwin lists in an editable form.

BACtwin-capable planning, engineering and testing tools should also be able to support the **JSON or XML** data formats. Both data formats enable media-free data exchange and direct further processing of BA mass data.

The BACtwin table is recommended as a template for exchanging BACtwin project data in JSON or XML format.

In addition, the MOU should be able to transfer dynamic data from the BA system to other IT systems (e.g. CAFM, ERP) via a secure interface.

The BACnet web service (BACnet/WS) in accordance with DIN EN ISO 16484-5 is preferably recommended for this. In Annex W to Z, the BACnet standard normatively defines the BACnet/WS RESTful WEB SERVICE INTERFACE and the XML and JSON formats for the BACnet web services. BACnet Web Services support TLS version 1.3.

The following figure shows an example of BACtwin-capable data exchange in JSON format (according to Annex Z of the BACnet standard).

```
{
  "$base": "Object",
  "displayName": "ORTS-BAS_420_VTA01_HZK01_HZV_PPE01_MOT01_SB~01",
  "acked-transitions": {
    "$base": "BitString",
    "value": "to-offnormal;to-fault;to-normal"
  },
  "description": {
    "$base": "String",
    "value": "Verteilanlage Heizkreis Muster Pumpe 1 Schaltbefehl"
  },
  "device-type": {
    "$base": "String",
    "value": "BO Schaltbefehl"
  },
  "elapsed-active-time": {
    "$base": "Unsigned",
    "value": "123"
  },
```


Figure 10 BACtwin-capable data exchange in JSON format (example)

The data formats **JPG, PNG, SVG, DXF** or **DWG** are recommended for data exchange of graphics.

For importing, for example, location information from BIM and exporting, for example, plant information in BIM, BACtwin-capable tools should have a **bidirectional IFC interface**.

4 Additional notes for BACtwin implementation

4.1 BA planning, participation of other project participants

In the case of a construction project, the builder/operator must ensure that the requirements for the BA are fully taken into account across all trades. To this end, he prepares documents such as operator concepts and specifications in accordance with [VDI 3814 Part 2.1], which are mandatory for all planners (GA, building services, building construction, etc.) and executing companies.

In the BA specification, the templates of the BACtwin library (e.g. addressing, object and aggregate templates) and the specifying operator requirement are integrated as a neutral, predefined basis for BA planning and execution with BACnet (see 4.11).

The BACtwin library supports BA planning, but does not replace it. Even in BACtwin projects, the builder or operator should consult qualified BA planning at an early stage. BA planning should use a current BACtwin-capable planning tool.

When commissioning the BA planning, the operator requirements, the building automation performance profile according to [VDI 3814 Sheet 2.2] and [VDI 3814 Blatt 4.2] and the recommendations of [AMEV BACnet 2017] and [AMEV BA 2023] that are valid at the time are taken as a basis.

According to [VDI 3814 Part 2.2], the basic services of BA planning include, for example, clarifying the use of existing addressing keys in LP 1 Basic Determination and applying an existing addressing key up to the plant level in LP 2 Preliminary Planning. In LP 3 Design Planning, they include applying an existing addressing key up to the operating equipment level, and in LP 5 Execution Planning, applying an existing addressing key up to the functional level (UAK).

The aggregate templates cover the majority of the required BACtwin templates for standard aggregates. For the overall function of the plants, it is usually unavoidable that the BA planning also develops project aggregates and project assemblies based on the BACtwin templates.

The object templates do not provide fixed parameters for certain BACS functions with wide areas of application, but instead provide permissible value ranges (default values). With these default values, the BA planning must specify the parameters that make sense for the project. As a prerequisite for its services, BA planning requires certain information and work results (e.g. lists of technical information) from other project participants (e.g. builder/operator, building planning, TBA planning).

The information required by BA planning and the BACS documents to be created by BA planning are listed in [VDI 3814 Sheet 2.2] and presented in [VDI 3814 Sheet 4.2] in editable table form (see Table 3 Checklist for Building Automation Planning).

The client must ensure that the other project participants provide the information required for system integration at an early stage in accordance with [HOAI] of the BA planning (see 4.10).

4.2 Character set and minimum number of characters

BACtwin-capable devices must support the character set UTF-8.

In addition, BACtwin-capable devices must support the Minimum Character_String_Length according to Table 23.

The minimum number of characters is based on Table K4 of the BACnet standard [DIN EN ISO 16484-5]. In State_Text, the number mentioned applies to all required states of multi-state objects (see Library 2, Tables 8.9 and 8.10).

No.	Property	AMEV profile	
		MOU	AS-C and AS-D
1	2	3	4
1	Object_Name	**64**	**64**
2	Description	**255**	**255**
3	Profile_Name	**64**	no V **Vorgabe**
4	Device_Type	**64**	**64**
5	Inactive_Text	**32**	**32**
6	Active_Text	**32**	**32**
7	State_Text	**32 (per state)**	**32 (per state)**
8a	Event_Message_Texts	**255**	**255**
8b	Event_Message_Texts_Conf	**255**	**255**
9	Location	**64**	**64**
10	Vendor_Name	**64**	no specification
11	Model_Name	**64**	no specification
12	Application_Software_Version	**64**	no specification
13	Firmware_Revision	**64**	no specification

Table 23 Minimum Character_String_Length

4.3 Priority control

Each BACnet object that can be controlled by an application has a Priority_Array property that can set the Present_Value property.

Output objects (AO, BO, MO) and virtual objects (AV, BV, MV) require Priority_Arrays e.g. for prioritization when switching control commands or setpoint specifications.

The Priority_Arrays prioritize these control commands so that applications with higher priorities override applications with lower priorities.

Table 24 defines the priorities of the Priority_Array in a BACtwin system in further development of [KBOB recommendation BACnet application]. Some Priority_Arrays serve as reserves for special use cases (see description).

If an organization has Priority_Array solutions that have proven themselves in the BA inventory, they can also be used in BACtwin projects.

Priority _Array	Application ([DIN EN ISO 16484-5] Tab. 19-1)	Recommendation	Description, example
1	Manual Life Safety	Manual Life Safety	e.g. Key control fire department
2	Automatic Life Safety	Automatic Life Safety	e.g. Fire switching/overcontrol by a fire emergency control
3	Available		(Reserve)
4	Available		(Reserve)
5	Critical Aggregate Control	Critical Aggregate Control	Override of the minimum on/off switching times if the overall damage prevented would be greater than possible damage to the device, e.g. B. load shedding
6	Minimum On/Off	Minimum On/Off	Switch-on/off times of objects, e.g. B. compressor refrigeration machine
7	Available		(Reserve)
8	Manual Operator	Override via MOU, BAE, AS or HMI	Manual switching via MOU, BAE, AS or HMI by a user
9	Available		(Reserve)
10	Available	Higher-level auto-matic operation	Override by central function, e.g. plaster lighting
11	Available		(Reserve)
12	Available	Timer	The object to be controlled is described by the Schedule object
13	Available		(Reserve)
14	Available		(Reserve)
15	Available	Automatic operation	Functions of the control of the automatic operation (program)
16	Available		(Reserve; previously: automatic operation)
-	Relinquish_Default	Relinquish_Default	Is used when configuring in the object set

Table 24 Priority_Array

4.4 Alarm und event management

Alarm and event management is used to document and manage all messages in the entire system. All reports and information must be kept decentralized by the AS. The current information must be accessible at any time from every MOU in the network. The operator must be able to acknowledge and reset alarms using MOU so that consistent alarm handling is guaranteed right up to the AS.

BACnet offers two different methods for alarm and event management:

- **Intrinsic reporting**
  Object-internal reporting supports message generation based on a single event (e.g. when the lower and upper limit values are exceeded (properties Low_Limit and High_Limit in analog objects) or when state changes occur in binary and multi-level objects. The message is configured in the object itself.

- **Algorithmic change reporting**
  Rule-based reporting is used to generate reports according to a specified algorithm from

one or more properties of one or more objects. The message is generated in an additional object of type Event Enrollment.

A large number of simple situations in which an alarm should be generated can be configured using Intrinsic Reporting (or COV/COS). The BACtwin library 2 shows examples of simple alarms in Table 8.1 AI templates (see Properties Low_Limit and High_Limit, COV).

Complex situations can be configured more flexibly with Algorithmic Change Reporting. For example, to increase the efficiency class of buildings through energy-relevant alarms, it makes sense and is necessary to use algorithmic change reporting for these alarms. Algorithmic change reporting then monitors e.g. manual interventions or deviations from switching states. When displaying complex alarms with Algorithmic Change Reporting, the relationships between original and mirrored data points in the EE object are transparently configured and can be recognized on the BACnet user interface or by testing tools. In BACnet systems with large, complex alarms, Algorithmic Change Reporting can be used as the sole alarm method to enable automated configuration checks.

The **Library 2** contains examples for algorithmic change reporting with event enrollment objects in Table 8.8 EE templates.

4.4.1 Notification class

The Notification Class objects are used to manage the recipients, priorities and acknowledgment requirements of BACnet alarms. The notification classes are specified in the Notification_Class property. The classifications describe the alarm category for system messages.

Table 25 below contains an overview of the recommended reporting classes. Message classes that are not required can be deselected (see Section 4.11). The operator requirements for reporting classes must be adhered to.

No.	Object_ Identifier	Reporting class designation	Priority	Ack_Required
1	NC100	Notification class Danger People	{10,11,110}	{true,true,true}
2	NC150	Notification class Danger Property	{15,16,115}	{true,true,true}
3	NC200	Notification class Alarm	{20,21,120}	{true,true,false}
4	NC250	Notification class Pre-alarm	{25,26,125}	{true,true,false}
5	NC300	Notification class Fault	{30,31,130}	{true,true,false}
6	NC350	Notification class Abnormal	{35,36,135}	{false,false,false}
7	NC400	Notification class Maintenance	{40,41,140}	{false,false,false}
8	NC425	Notification class Maintenance (can be acknowledged)	{42,43,142}	{true,false,false}
9	NC450	Notification class Revision	{45,46,145}	{false,false,false}
10	NC500	Notification class Local override	{50,51,150}	{false,false,false}
11	NC600	Notification class System	{60,61,160}	{true,false,false}
12	NC700	Notification class Trend	{70,71,170}	{false,false,false}
13	NC800	Notification class Miscellaneous	{80,81,180}	{false,false,false}

Table 25 Notification class

The three states „to-offnormal,to-fault,to-normal“ are defined for each NC instance in the property priority of the NC objects. Table 26 contains recommended parameters. The use of different priorities for the different states serves to classify the messages according to priorities or according to the causes of the messages.

In the Ack_Required property (acknowledgment required) of the NC objects, the requirements for acknowledging messages are configured with three specifications {to-offnormal,to-fault,to-normal}. Table 26 contains recommended parameters (see also Table 8.7 NC templates). Project-specific specifications must be made in the Recipient_List property of the NC objects.

Depending on the cause of the message, the messages are assigned to either the “Alarm” or “Event” type. The assignment is made in the object templates via the Notify_Type property, in which e.g. B. Fault and alarm messages are generally assigned to the “Alarm” type and non-critical messages such as operational messages and TL messages are assigned to the “Event” type.

Feedback from local priority operation must be provided and must trigger an alarm with message class NC500 (manual intervention) when the status changes to manual operation.

4.4.2 Event_Type

The following Event_Types are recommended to support Algorithmic Change Reporting (excerpt from BACnet standard Rev.16 Table 12-15):

Event_Type	Application example
Change_Of_Bitstring	Monitoring of hand positions on the module (Overridden) and hand positions via the control unit (Out_Of_Service)
Change_Of_State	Monitoring of states of binary or multi-level values
Change_Of_Value	Monitoring of setpoint changes
Command_Failure	Monitoring of execution controls
Floating_Limit	Monitoring of deviations
Out_Of_Range	Monitoring of limit values

Table 26 Event_Type für Algorithmic Change Reporting

4.4.3 Message text

The message texts in the Event_Message_Text and Event_Message_Text_Config properties contain information with which the BA operators are informed about the type of alarms or events using three array entries (e.g. danger: ...).

In existing systems, the message texts were usually designed individually based on suggestions from the BACnet manufacturers or specifications from builders and operators. In BACtwin-capable systems, the message texts are standardized uniformly and manufacturer-neutrally.

Three variants can be used as message texts:

- **Variant 1**: Danger people: [plain text], error: [plain text], normal: [plain text]
- **Variant 2**: [UAK]/[Plaintext], [UAK]/[Plaintext], [UAK]/[Plaintext]
- **Variant 3**: [Plain text], [Plain text], [Plain text]

Plain text is usually the description, but it can also be chosen differently. The desired standard specification (section 4.11) is entered in the object templates (except CAL and DEV).

The minimum character numbers for Event_Message_Text and Event_Message_Text_Config are listed in Table 24 Minimum Character_String_Length. This character count applies to each of the three array entries.

4.4.4 Event_Algorithm_Inhibit

Message shower suppression can be set up either with the Event_Algorithm_Inhibit property or the Event_Algorithm_Inhibit_Ref property.

Report shower suppression must be set up if a report results in further reports for technical reasons.

In order to avoid pulsating alarm messages (message showers) for I/O objects with the message classes NC300 (fault), NC400 (maintenance), NC420 (maintenance, acknowledgable) and NC450 (revision), an appropriate delay time must be entered in the Time_Delay property (see object templates in library 2).

4.4.5 Reliability suppression

The property Reliability_Evaluation_Inhibit can suppress the reliability check. but is not mandatory. If it is present, the reliability suppression must be switched off (i.e. test result: "FALSE").

4.4.6 Execution control

For execution control with intrinsic reporting (e.g. BO_SC[1]), the value that represents the physical state of the data point to be monitored must be programmed to the Feedback_Value of the output object.

The same procedure should be followed for execution control with algorithmic reporting (e.g. EE_CMDF[1]).

4.5 Time management

The MOU must be able to read and write access to the calendar and schedule objects in the network. The entries must be requested from the builder or operator and documented in the MOU by the person carrying out the work.

4.5.1 Calendar object

Calendar objects contain a list in which e.g. holidays, company holidays or other events can be entered on which an Exception_Schedule (special schedule) is valid. Entries are possible as a date (e.g. 01/01/2012), date range (e.g. 01/01/2012 - 06/01/2012) or recurring day (e.g. 06/01).

The number of calendar objects must be agreed with the builder or operator. If there is no coordination, at least **3 calendar objects** must be available per AS. At least **15 date** entries can be created per calendar object.

4.5.2 Schedule object

Schedule objects change states or values according to the setting values of weekly programs and special schedules and depending on the date and time. For example, acts on virtual data points such as “entire system operating mode”, on operating parameters such as setpoints or on physical output functions.

Each AS must provide at least the number of schedule objects required by system. At least **12 switching times (6x on-off)** per weekday can be created in each Property Weekly_Schedule. At least **6 date entries or calendar object references** can be entered in each Exception_Schedule property. At least **12 switching times (6x on-off)** can be created in each Exception_Schedule property.

4.5.3 Time synchronization

The operator must create a time synchronization concept that should take the following into account.

The AS must have an integrated and battery-backed system clock for autonomous operation. The automatic time synchronization in the **BACnet/IP** network must take place via a BACnet time master, usually the MOU. An additional time synchronization, e.g. B. via an NTP server must not be set up in parallel. The AS use the system time received from the BACnet Time Master.

In the **BACnet MS/TP** network, time synchronization can be done in different ways and must be considered on a project-specific basis.

4.6 Trend recording

The recording of process values for short- and long-term archiving takes place in the AS in TL objects. Trend recordings can severely impact BA performance on the network. Their use and configuration require special care. Only standardized properties from the BACnet objects may be recorded, not proprietary values. For control purposes, the property Log_DeviceObjectProperty must be maintained and evaluated.

TL objects are programmed in the AS to which the referenced objects are physically connected. All TL objects must be set up as ring buffers, i.e. Stop_When_Full = FALSE. If the number of newly saved trend values set in the Property Notification Threshold is reached, the TL object sends a message to the MOU that the trend values should be read out.

Notify_Type must be parameterized to “Event” in all TL objects. In TL objects, Event_Enable must only be parameterized to “to-normal” (special case: Buffer_ready).

Trend recordings can be set up either event-oriented (COV) or cyclically (POLLING). In the BACtwin library 2, these specifications are defined in Table 8.9 TL templates in the Logging_Type property.

Trend recordings with POLLING

TL objects that are intended to regularly document certain states, values or trends (e.g. consumption developments, measured values for adjustments or operational analyzes) must be created in the AS with fixed intervals in the Log_Interval property (in sec.) (POLLING).

All TL OBJECTS with POLLING must be synchronized. This is done by activating the Align_Interval property or specifying a fixed start time. The MOU must automatically query trend data regularly (e.g. at least every 24 hours) to ensure secure archiving without data gaps.

Trend recordings with COV

Only trends for irregular events (e.g. operational messages, setpoints) are recorded in the AS in an event-oriented manner using COV. With COV, only changes in the system status (COV) that exceed the set COV_Increment (change threshold) are recorded. The changes can be viewed in the buffer memory.

The COV_Resubscription_Interval property is only used for trend logs on third-party controllers.

4.6.1 Regulation

The standard parameters in the object templates contain the recommended setting values for standard aggregates. If project-specific aggregates are planned with the consent of the client

or operator, the associated parameters must be checked by the BA planning and determined as required.

The standard parameters refer to the adjustment phase. The setting values for the properties Log_Interval (for POLLING) and COV_Increment (for COV) were chosen to be more sensitive for the adjustment phase than the setting values for later control operation, so that undesirable operating states can be detected early during adjustment.

In special cases (e.g. heat pump), trend recordings with POLLING (e.g. power, heat quantity) or COV (e.g. operating time, temperature) can be useful. The optimal setting must be determined during adjustment.

During commissioning, the selected parameters and all other recommendations must be tested by the adjustment management (ERM) according to [AMEV TMon 2020] with the help of data recordings (trend log) and the practical suitability must be verified on site.

If more suitable parameters are determined during adjustment, these should - after coordination with the specialist planning - be preferred to the standard parameters and documented with the date (yymmdd) in the handover documents and handed over to the operator.

The network load must also be taken into account when adjusting: In order to limit the network load in regular operation to a sensible level, the last step in adjusting the trend log objects is to double the log intervals in the Log_Interval property using POLLING. For trend log objects using COV, the COV thresholds in the COV_Increment property are doubled.

4.6.2 Memory size and reporting threshold

The property Buffer_Size (memory size) of the AS must be dimensioned such that if the MOU fails, the trend recordings are retained on the AS for at least 24 hours.

Settings of 35 - 45% of the Buffer_Size are recommended for the Notification_Threshold property. A value of around 40% ensures that, in the event of technical disruptions in the network, a message can fail without causing data gaps. By staggering the Notification_Threshold setting values in the AS, the threshold values are not exceeded at the same time.

For increased requirements, Notification_Threshold should be chosen smaller, e.g. B. 10% of the Buf-fer_Size (approx. 1 day). At the same time, Buffer_Size must be made larger for storing the trend log data in the AS (e.g. 10 days supply).

In addition, a historization server should query the data cyclically.

4.7 Loop object

Controllers must be created according to the planned control strategy and set up with the associated parameters. The controller performance is checked during commissioning. To do this, certain objects must be set to trend (see Section 4.6.1 Regulation).

The Setpoint_Reference property (address of the setpoint) must contain a reference. The Setpoint property shows the value of the object in the Setpoint_Reference property.

In the loop objects of AS with the AMEV profile AS-C and AS-D, intrinsic reporting is not required (in contrast to AS with the AMEV profile AS-B). If intrinsic reporting is still used in loop objects, the properties are set up according to the specifications of the Loop object template (Library 2, Table 8.8).

4.8 Availability, number of outages and downtime

If technical reliability is particularly important and needs to be monitored in technical systems (e.g. conveyor systems, own power supply systems, low-voltage switchgear), e.g. the following parameters are used and continuously evaluated.

The counter availability value (CAV) per day is determined from the full day (1,440 minutes) minus the sum of downtimes (not ready for operation, collective fault) in relation to the day.

The counter number of failures (CFL) counts the sum of the fault reports in one day.

The Counter failure time average (CTA) counts the sum of downtimes divided by the sum of reports in a day.

The Counter failure total time (CTT) counts the sum of the downtimes in one day plus the value from the previous day. The total time of the failures can be evaluated in order to initiate necessary follow-up measures (e.g. maintenance, repair or replacement of the system). In these cases, the count value is reset via a virtual BACnet object.

Availability, outages and downtime are calculated daily at midnight. The value is represented as a TL object over the time unit of the full month. The TL object is saved according to the trend recording specifications.

4.9 BACtwin-capable gateway, field device and compact system

Paragraph 71a of the Building Energy Act requires cross-manufacturer and cross-technology communication of all building technology systems and applications.

BACtwin-capable **field devices**, **gateways** and data processing systems of **compact systems** (e.g. for ventilation, air conditioning, heat recovery) must meet the minimum requirements for objects, properties, conformance codes and parameters that are necessary to reproduce the corresponding standard aggregates, assemblies or plants.

Proof of the BACtwin capability of compact systems must be provided by means of an AMEV attestation (see 4.10 BACtwin-capable integral building automation, penultimate section).

If trade-specific building automation systems cannot meet the necessary requirements of the AMEV BACtwin, these technical data processing systems must be tendered separately from the trade and delivered (with proof of their BACtwin capability) by the data handling system installer. The BACtwin capability must be clarified in the planning phase between trade planners and building services planners.

The BACnet-capable gateways, field devices and data processing systems of compact systems must be implemented according to the BACtwin concept. The following points must be noted:

- The addressing must be set up in the property Object_Name according to user-specific location UAK and BACtwin UAK as well as in the property description with user-specific plain text.
- BACnet objects must be represented according to the BACtwin concept, actually made available to the operators and be able to be checked automatically.
- No additional objects may be billed to display the alarm if the alarm is provided with object-specific properties (intrinsic reporting).
- Schedules entered in the foreign protocol must be able to be operated and monitored in BACnet Calendar and Schedule objects.

- The alarm display on local operating and display devices must correspond to that in the BACnet objects, even when alarming is deactivated.
- The time synchronization via BACnet must be effective and any further time synchronization must be switched off.
- Trend log objects provided in BACtwin templates must also be provided for BACtwin-capable field devices and compact systems.
- The representation of the data recording on local operating and display devices must correspond to the recording in the BACnet Trend Log objects.
- For counters, the values can be executed with the object type AV (without property Device_Type) or with AI (like AV, but with property Device_Type). The aggregate templates use the AV templates defined in library 2.

4.10 BACtwin-capable integral building automation

Regulations such as [DIN EN 15232] Energy efficiency of buildings from 2012 and the following 2019 [ISO 52120-1] Energy performance of buildings describe a new, needs-oriented, optimized regulation and control (see Figure 2 [ISO 52120-1]).

In the past, plant automation (in VDI 3814) and room automation (in VDI 3813) were generally considered separately. With this perspective, the plant automation systems had to provide different media (e.g. heat, cold, air) and the room automation could use these media as required. The changed perspective according to [ISO 52120-1] was adopted with the merger of VDI 3813 and VDI 3814.

The most important objective according to [ISO 52120-1] is needs orientation, from which it follows, for example:

- Room automation must be equipped with occupancy detection devices.
- Transmit demand values from the room automation to the system automation, in order to enable needs-based and energy-saving generation, storage and distribution in the various system automation systems.
- Integration of system and room automation across media and systems, in order e.g. to prevent simultaneous heating and cooling and to exploit the energetic advantages of dead zones (zero energy band).

[VDI 3814 Part 2.2] defines system integration as the automation networking of individual technical subsystems and their functional integration into a BA system. The **aim of system integration** is to set up a cross-trade BA system for the area under consideration (e.g. building, property) and the technical systems contained therein with as few different communication protocols as possible (**minimization of communication interfaces**).

With BACtwin, the BACS information is available for needs-oriented operation regardless of the manufacturer. The neutral BACtwin data model offers a good basis for implementing integral regulation and control strategies in new buildings and renovations.

In the construction project, the builder/operator must involve the BA planning already in LP 1 Basic Determination in order to ensure the necessary integration planning for the room and system automation in accordance with the BA operator concept.

According to [VDI 3814 Part 2.2] and [VDI 3814 Part 4.2], the basic services of BA planning in LP 1 Basic Determination include, among other things, the clarification of the tasks for the GA on the basis of the specifications or the client's requirements planning in consultation with the project planner and the parties involved in the other specialist planning. Of particular importance are the **addressing key** and the **BA specification sheet** with the BACtwin-capable operator specification according to 4.11.

In LP 2 preliminary planning, the basic services of BA planning include, among other things, the clarification and consideration of the BA efficiency class ([DIN EN 15232]) or the degree of automation ([DIN V 18599-11]), the compilation of the requirements for the parties involved from the specification of the BA efficiency class and the clarification of the scope of the system integration (i.e. application of the system integration tables according to [VDI 3814 Part 4.2] at least in the first column "Integration").

In LP 3 Design Planning, the basic BA services include, among other things, the definition of the scope of system integration (i.e. application of the system integration tables).

The early involvement of BA planning ensures that the BACtwin specifications are defined by BA planning across trades for the components of the building construction (e.g. sun protection) and technical equipment (e.g. heating, cooling, lighting). These specifications must be implemented in the tenders of the respective trades.

Reference is made to German [Gebäudeenergiegesetz] Section 4 (public sector obligation to provide information) and Section 108 (1) No. 14 (administrative offenses).

4.11 BACtwin-capable operator requirement

As part of the requirements planning, which defines quality objectives such as utility value and sustainability, the client/operator or on his behalf prepares a **BA specification sheet** in accordance with [VDI 3814 Part 2.1] for a construction project. The builder/operator compiles the specifications for the BA and for the systems to be integrated in the BA specification (see [VDI 3814 Part 2.2]).

Organizations with a large number of properties, buildings or facilities (e.g. municipalities, states, federal administrations, etc.), also use the BA specification as a standard template for the planning and execution services of further construction projects and as a basis for a quality management process accompanying the project or construction.

It is recommended that the builder/operator bindingly agree on the AMEV recommendation **BACtwin 2024** together with the user-specific **operator requirement** as a BACnet-specific BA specification in construction projects.

For this purpose, the specification of the operator requirement is used as a comprehensively predefined basis for the planning and execution of the BA with BACnet and integrated into the GA specifications as a binding specification.

In the operator requirement, the organization must complete the data model with the user-specific Location UAK (see Table 27, lines 4 to 6) and specify the functional UAK (see Table 28, lines 7 to 16) – analogous to the UAK example in Library 1.

In addition, the organization must decide on the variants possible in the BACtwin data model and determine which of the variants (e.g. Table 27, lines 26 and 27) should be implemented in her construction projects.

In the operator requirement, the organization must define a clear **Location UAK** for the entire real estate portfolio in the sense of a consistent minimum standard (example in Figure 2).

The organization can leave open the standard solutions to be executed for **reporting** using BI, MV or EE objects. Alternatively, undesirable methods can be excluded from LO/ID.

The possible options for **execution control** are to be treated in the same way.

Individual recommendations from BACtwin 2024 (e.g. length of the function UAK, description, property responsibilities) can be adapted by the organization across the organization or supplemented and documented on a project-specific basis.

However, **different specifications must not be made** due to different preferences and interpretations **in individual projects**, as this would result in the loss of essential advantages of the BACtwin concept. The possibility of neutral evaluations in accordance with [Building Energy Act] § 71a building automation must be retained.

In Table 27 Operator requirement, the organization must enter the selected data model options to be implemented in column 3 (as user-specific "**BACtwin settings**").

Detailed operator requirements should be specified in the BACnet specifications in verifiable table form (based on the BACtwin library). We recommend specifications in the form of export files, e.g. B. from a sample project of a BA planning tool.

In the case of special solutions (e.g. individual templates for special objects, aggregates, assemblies and plants), significant advantages of the BACtwin concept are lost. Each special solution is associated with increased effort and risk, as it cannot be checked automatically with BACtwin-capable testing tools. For this reason, builders and operators should **avoid special solutions** as much as possible.

In order to be able to close any gaps in standardization (e.g. innovations, proposals for better or new translation) in a timely manner and to adapt the BACtwin-capable tools, relevant contributions or inquiries are welcome to the AMEV office (please send an email to: amev@bmwsb.bund.de).

No.	Area	Recommendation according to AMEV BACtwin 2024	Operator specification
	1	2	3
1	**BACtwin specification**	Minimum standard of the operator	
2	**AMEV profile**	AS-C according to BACtwin library 2	
3	**AMEV profile**	AS-D according to BACtwin library 2	
4	**Location UAK**	Number of Location UAK blocks: …….	
5	Number of characters	Including separators): …… characters	
6	Example Location UAK	……	
7	**BACtwin UAK**	According to BACtwin library 1 and section 2.1	
8	Syntax	According to table 2	
9	Trade	Cost group according to DIN 276-1 (numerical)	
10	Plant	Addressing of partial plants	
11	Room automation	Adressing of room automation	
12	OE function extension	Terminal, with length difference (no tildes)	
13	Numbering	Two-digit numbering according to section 2.1.9	
14	Number of characters	Including separators: …… characters	
15	Example BACtwin UAK	……	
16	Existing UAK	Translation tool according to section 2.1.15	
17	**Description**	Blocks see example Description section 2.1.11	
18	Number of characters	Including separators: …… characters	
19	**Object templates**	According to BACtwin library 2 and section 2.3	
20	Priority_Array	According to BACtwin library 2 and table 24	
21	Notification_Class	According to BACtwin library 2 and table 25	
22	Message Text	According to Section 4.6 Variant: ……..	
23	Time synchronization	Operator concept according to section 4.5.3	
24	Responsibilities	According to BACtwin library 2 and table 18Ta-	
25	**Aggregate templates**	according to BACtwin library 3 and section 2.4	
26	Execution control	Variant 1.1 (BO), 1.2 (addit. EE):……..	
27	Manual message LO/ID	Variant 2.1 (BI), 2.2 (MV), 2.3 (EE): ……..…	
28	Assembly templates	According to BACtwin library 3 and section 2.5	
29	Plant templates	According to BACtwin library 3 and section 2.6	
30	**Planning tool**	According to section 3.1 and table 19	
31	**Engineering tool**	According to section 3.2 and table 20	
32	**Scan tool**	According to section 3.3 and table 21	
33	**Test tool**	According to section 3.3 and table 22	
34	**Data exchange formats**	According to section 3.5	
35	**Implementation**	BACtwin implementation according to chapter 4	
36	**Gateway, field device**	BACtwin-capable according to section 4.9	
37	**Compact system**	BACtwin-capable according to section 4.9	
38	**Integral BA planning**	According to sections 4.1 and 4.10	

Table 27 Operator requirement

5 Thanks for cooperation

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Anhang 1 AMEV Attestation AS-C und AS-D (Form)

AMEV

Mechanical and Electrical Engineering Working Party
of National, Regional and Local Authorities

.....

BACnet Certification Body

AMEV Attestation for Certified BACnet Devices

1. The following BACnet device is certified as per DIN EN ISO 16484-5:

Supplier		
Product name		
Product model number		
Standard device profile		**BACnet Protocol Vers. / Rev.**
Firmware revision		

Data link Layer Options	☐ **BACnet IP (Annex J)**	☐ **BACnet over LonTalk**
	☐ **BACnet MS/TP master**	☐ **BACnet MS/TP slave**
	☐ **MS/TP baud rates:** ……	
Stat. device Binding	☐ **Yes (for MS/TP only)**	
Networking Options	☐ **BBMD**	☐ **Registr. by external devices**
	☐ **Router, medium:** ……	
Character set	☐ **UTF-8**	
Reporting options	☐ **Intrinsic Reporting**	☐ **Algorithmic Reporting**

2. The device supports BACnet functions as per AMEV profile:

☐ **AMEV profile AS-C** (according to BACtwin 2024, without SV object) As of**:** .....
☐ **AMEV profile AS-D** (profil AS-C and SV object according to BACtwin 2024) As of**:** .....

3. Basis for AMEV Attestation:

☐ **Test report of Test lab** …….. dated…... number ……
☐ **AMEV recommendation BACtwin 2024** As of:: ..... (see www.amev-online.de)

4. The AMEV Attestation is only valid in combination with the certificate:

☐ **Certificate number.**……(see http://bacnetinternational.net/btl/)

(location, date) ……

…….. **……..**

(AMEV chair BACnet) (BACnet Certification Body)