General Technical Requirements

for

Reference Designation, KKS Guideline

GTR-21

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Reference documents

ISO 14084-1	Process diagrams for power plants Part 1: Specification for diagrams
ISO 15519-2	Specifications for diagrams for process industry Part 2: Measurement and control
VGB B101e	Reference Designation System for Power Plants, RDS-PP Letter Code for Power Plant Systems (System Key), Edition 3, 2011
VGB B105e	KKS Identification System for Power Plants Guideline for Application and Key Part, Index A, B, C + D, Edition 7, 2010
VGB B106A e	KKS-Application Explanations. Part A KKS-Identification System for Power Stations, Edition 2004
VGB B108	Rules for the creation of denominations and their application for power plant engineering
GTR-3	Documentation
GTR-16	Marking and labeling
Annex-10	Reference designation, KKS letter codes for functions

1 Scope and application

This General Technical Requirement (GTR-21) specifies rules and guidelines for:

- Use of reference designation in diagrams
- Creation of designations and denominations of technical objects
- Technical object designation for equipment, components and signals within civil, process, mechanical, electrical, instrumentation and control systems.
- Letter codes for identification of measured values and their application within process control.

Functional designations for objects are specified in plant specific documents.

The use of reference designation, for identification / numbering of documents, is described in GTR-03: Documentation.

The use of reference designation, for marking and labelling of components, is described in GTR-16: Marking and labelling.

Identification of geographic location of objects is given as data attached to the technical object designation. Specifications for creation of data set for geographical location will be given in a plant specific document.

2 Reference designation basics

2.1 Introduction

Reference designation described in this GTR-21 is based on VGB publications: "B106e:2004 KKS Application Explanations" and the Employer's general practice for reference designation in power plant units.

This means that reference designation described in this GTR-21 is not in strict coherence with the official VGB guideline B106e, but represents a merge of the official guidelines and the Employer's general practice.

2.2 Brake down levels general

A reference designation code for a technical object is a hierarchic alphanumeric structure with following four breakdown levels with increasing detailing in order to classify and unequivocally identify the object:

- Unit
- Function
- Equipment
- Component

Table 1 illustrates the breakdown of the reference designation for object "AMV04 LAB10AA001 -M01", which "decoded" is an electrical actuator (-M01), for a valve (AA001), in feed water system (LAB10), in unit (AMV04).

Table 1 - Illustration of the four breakdown levels for an object

Level	Unit	Function	Equipment	Component
Unit	AMV04			
Function		LAB10		
Equipment			AA001	
Component				-M01

The understanding of the function, equipment and component aspects are essential for practical use of reference designation in general and creation of correct reference designation for an object.

Figure 1 shows the breakdown systematics for a typical process system from function to component level.

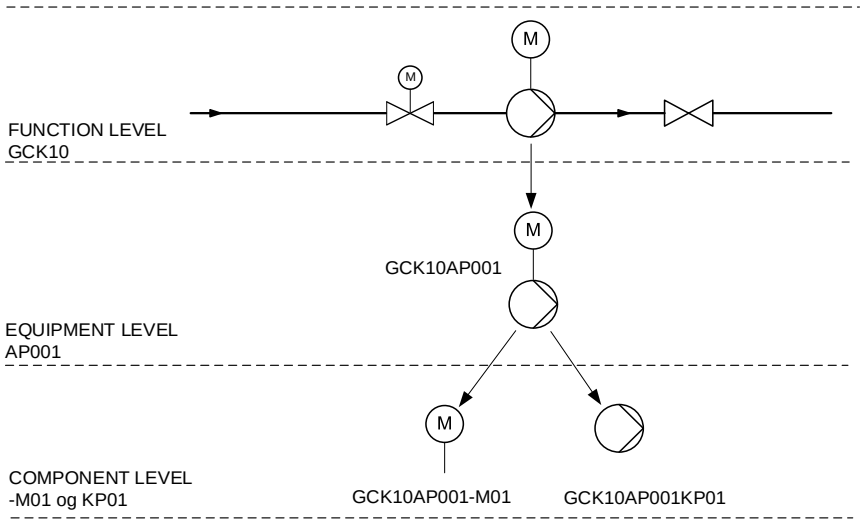


Figure 1 - Illustration of break down levels in a process system

2.3 Reference designation structure

The reference designation system allows creation of reference designation codes for practical application on different levels. Table 2 shows possible reference designation codes.

Table 2 – Possible reference designation codes for technical objects

Breakdown level	Reference designation code	Description
Unit	AMV04	Unit 04
Function	AMV04 L	Unit 04, Steam, water, condensate systems
	AMV04 LA	Unit 04, Feed water system
	AMV04 LAB	Unit 04, Feed water piping system
	AMV04 LAB10	Unit 04, Feed water piping system 10
Equipment	AMV04 LAB10AA001	Unit 04, Feed water piping system 10, valve AA001
Component	AMV04 LAB10AA001 –M01	Unit 04, Feed water piping system 10, valve AA001, electrical actuator –M01

The letter code string of a full reference designation shall have spaces as illustrated with underscore in following example: AMV04_LAB10AA001_-M01.

OBS: The underscore signs are only for illustration, not part of the of the reference designation.

2.4 Reference designation block

A reference designation code has a hierarchic alphanumeric structure with up to four breakdown levels with increasing level of detailing in order to classify and unequivocally identify all objects.

The structure of a reference designation block is illustrated in Figure 2.

Beak down level	0	1			2			3	
Designation	Unit	Function			Equipment			Component	
Alphanumeric characters	AAANN	(N)	AAA	NN	AA	NNN	A	AA	NN
(Reference)	1	2	3	4	5	6	7	8	9

A = Letters, N = Digits

Figure 2 - Structure and break down of a reference designation block

2.5 Breakdown Level 0 "Unit"

This breakdown level defines the various units or common systems not belonging to a specific unit, within a power plant.

Breakdown level 0 for unit – see figure 3 - is composed of following elements:

AAANN (ref 1) Letter / digit coding of units.

Beak down level	0	1			2			3	
Designation	Unit	Function			Equipment			Component	
Alphanumeric characters	AAANN	(N)	AAA	NN	AA	NNN	A	AA	NN
(Reference)	1	2	3	4	5	6	7	8	9

Figure 3 - Structuring of break down level 0: Unit

If no confusion can arise, the unit designation break down level 0, can be omitted.

In documents with reference designation from two or more units, the in front unit designation, break down level 0 reference, shall always be used.

2.6 Breakdown Level 1 "Function"

Breakdown level 1 for function – see figure 4 - is composed of following elements:

(N) (ref 2) 1-digit coding. Applies only in case of two or more main systems within a unit e.g. two parallel boilers. If not used (N) (ref 2) shall be omitted.

AAA (ref 3) 3-letter coding of functions, which is defined in a plant specific document.

NN (ref 4) 2-digit serial numbering, which is described in this document

Beak down level	0	1			2			3	
Designation	Unit	Function			Equipment			Component	
Alphanumeric characters	AAANN	(N)	AAA	NN	AA	NNN	A	AA	NN
(Reference)	1	2	3	4	5	6	7	8	9

Figure 4 - Structuring of break down level 1: Function

The 3 letters (ref 3) constitute a function specific subdivision of the overall unit into functional process systems, auxiliary systems or building structures.

2.7 Breakdown level 2 "Equipment"

Breakdown level 2 for equipment – see figure 5 - is composed of following elements:

AA (ref 5) 2-letter coding of equipment, which is defined in Annex A.

NNN (ref 6) 3-digit serial numbering, which is defined in Annex A

A (ref 7) 1-letter coding of additional equipment information e.g. manually operated valves with limit switches, where A=open and B=closed position.

If not used, A (ref 7) can be left out.

A (ref 7) must not be used, if the object is assigned a typical diagram – see section 4.6 for application of typical diagrams.

Beak down level	0	1			2			3	
Designation	Unit	Function			Equipment			Component	
Alphanumeric characters	AAANN	(N)	AAA	NN	AA	NNN	A	AA	NN
(Reference)	1	2	3	4	5	6	7	8	9

Figure 5 - Structuring of break down level 2: Equipment

For manually operated valves, dampers etc. with limit switches, the serial number (ref 6) in the reference designation for the limit switches shall be the same as for the object (valve, damper) they are part of.

2.8 Breakdown level 3 “Component”

Breakdown level 3 for components – see figure 6 - is composed of following elements:

AA (ref 8) 2-letter coding of components, which are defined in Annex B.

For electro-technical components the first letter is replaced by a dash "-"

NN (ref 9) 2-digit serial numbering

Beak down level	0	1			2			3	
Designation	Unit	Function			Equipment			Component	
Alphanumeric characters	AAANN	(N)	AAA	NN	AA	NNN	A	AA	NN
(Reference)	1	2	3	4	5	6	7	8	9

Figure 6 - Structuring of break down level 3: Component

3 General rules

Establishment of a reference designation structure for a process plant or process system is based on a sequential break down process with following main topics:

- Identification of functional systems – 1. letter in the functional designation "AAA (ref 3)"
- Identification of interface limits between functional systems
- Identification of functional sub systems - 2. and 3. letter in the functional designation "AAA (ref 3)"
- Identification of interface limits between functional sub-systems
- Numbering of functional sub-systems following the decade or serial concept, depending of the complexity of the individual systems

The decided reference designation structure down to numbered functions and their interface limits shall be documented in process flow diagrams (PFD) each covering 1. letter functional systems.

4 Structuring of numbering of process systems

4.1 Numbering

4.1.1 General

The number elements of the breakdown level references (ref 4), (ref 6) and (ref 9) have a numbering (counting) structure to be used in one or more of the following ways:

- The numbering starts once more when one of the preceding underlined letter codes, (ref 3) AAA, (ref5) AA or (ref 8) AA changes.
- The numbering can be consecutive or grouped.
- Preceding zero-digits must be written.
- 00 and 000 shall not be used for serial numbering
- later addition of sub-systems e.g. within a decade should be taken into account

4.1.2 Geographically determined numbering

In case when the flow direction does not provide an unequivocal rule of numbering, the numbering shall follow the geographical numbering rules given in below:

Priority 1: Down → Up

Priority 2: South → North

Priority 3: West → East

4.2 Decade numbering of process system

Numbering of process systems shall predominant follow the decade principle.

Structuring using the decade concept must consider the number of available decade in order to obtain a logical / easy recognizable structure,

In figure 7 is illustrated decade numbering of a process system consisting of two functional group each consisting of three pumps and three heaters. These functions are numbered continuously within the decades. This numbering concepts contributes to establish logical and recognizable groups.

Numbering within a decade shall follow the serial numbering concept – see figure 8.

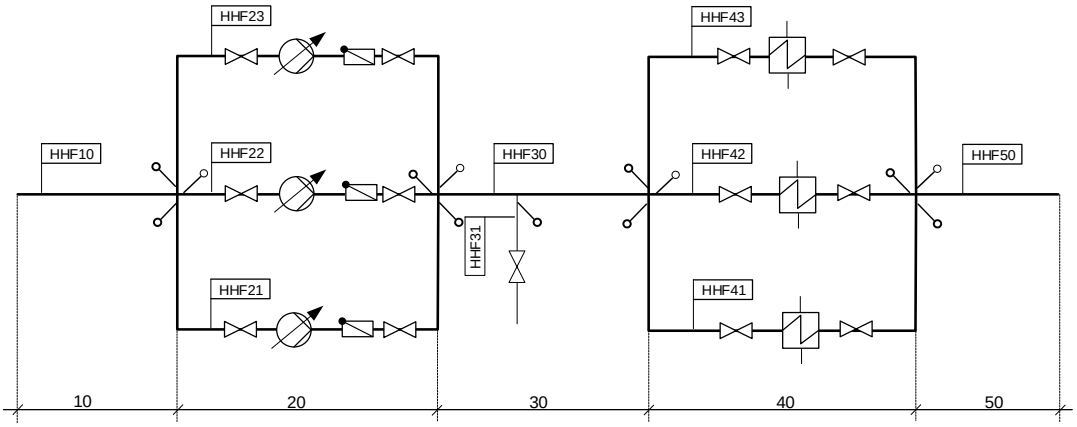


Figure 7 - Example of decade numbering

The above numbering concept can be used for functions, which have no associated auxiliary sub-functions.

Numbering of pump groups, where the individual pumps can have associated sub-equipment, must be made with decade numbering as illustrated in figure 8. This concept gives "numbering space" for up to nine sub-functions for each pump.

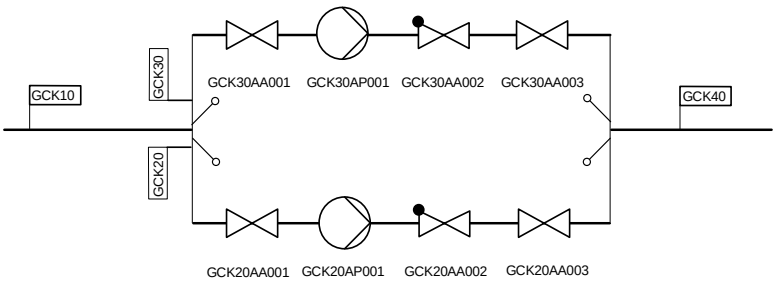


Figure 8 - Example of decade numbering to allow numbering space for pump sub-systems

4.3 Numbering of 2-pipe systems

In 2-pipe systems e.g. closed cooling water system, the valves in forward and return for a heat exchanger shall be numbered with same equipment number e.g. PGA31 and PGB31 – see figure 9.

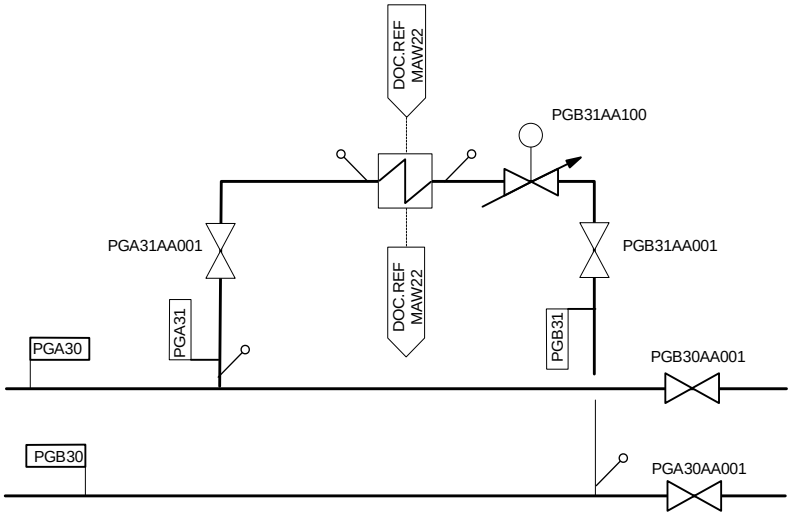


Figure 9 Example of numbering of circulation systems

4.4 Numbering of boiler burners

Burners shall be numbered to secure a logical relation between the fuel firing systems and related fuel injection systems / burners. Figure 0 illustrates eight burners organized in four elevations. The numbering follows the rules: Down → up and West → east.

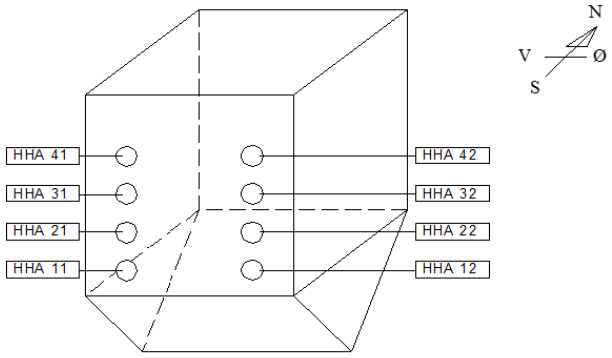


Figure 10 Numbering of burners in a boiler

4.5 Functional systems involving several functions

Functional systems e.g. heat exchangers, which have functional relations to auxiliary heating or cooling systems, shall be numbered, as part of their main / auxiliary systems to which they belong – see figure 11.

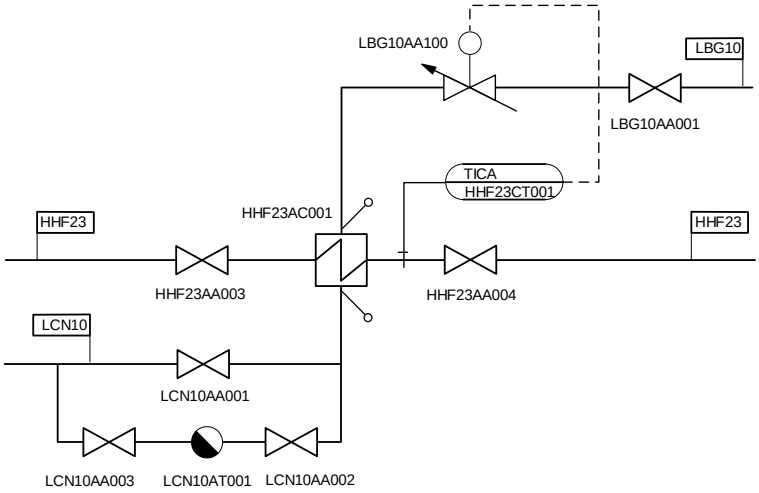


Figure 11 Numbering of a functional system involving several functions

4.6 KKS numbering using typical diagrams

Typical diagrams (TYD) are used for structuring and standardizing of the interfaces between process objects controlled by the DCS system and / or includes an electrical motor or electrical actuator.

Objects in a typical are designated reference designation on component level. A table of reference designations will indicate which objects shall be registered in the database and which shall be provided with component tag according to GTR-16.

For a process object e.g. an on-off valve with pneumatic actuator a coherent set of typicals are prepared consisting of:

- a mechanical typical showing the objects with interface to the DCS system and to the instrument air supply
- a DCS typical showing the wirering to the DCS system (hard wired or Profibus)

For a process object e.g. an on-off valve with electrical actuator the set of typicals will consist of:

- a mechanical typical showing the objects with interface to the DCS system and electrical supply (MCC)
- a DCS typical showing the wirering to the DCS system (hard wired or Profibus)
- an electrical typical showing the wirering to the MCC and to the DCS system

For a process measurement points (instrumentation) the set of typical will consist of:

- a combined typical and hook-up drawing showing the objects with interfaces to DCS system and eventually electrical supply.
- a DCS typical showing the wirering to the DCS system (hard wired or Profibus)

- an electrical typical showing the wirering to the MCC and to the DCS system

The coherence between a set of mechanical, DCS and/or electrical typicals, is secured by using same document serial number.

DCS and electrical typicals are used for wirering and choice of interfaces to DCS and MCC systems.

The in force collection of typicals for a specific project will be made available for the Contractors, shortly after signing of agreements.

If need for a new typical the Contractor shall submit a draft to the project groups in charge of the DCS and MCC systems, who will approve the proposal and made in force for the project.

4.7 Instrumentation

4.7.1 Piping and instrumentation interfaces

Interface between piping and instrumentation shall be numbered as follows – see Figure 22:

Temperature measurement:	Thermowell belongs to instrumentation. Reinforcement boss belongs to piping – see figure 12A
Pressure measurement:	Instrument root valve belongs to piping – see figure 12B
Inline instrument devices	The inline instrument device e.g. venturi nozzle, is part of measurement point. Instrument root valves are numbered as part of piping - see figure 12 C

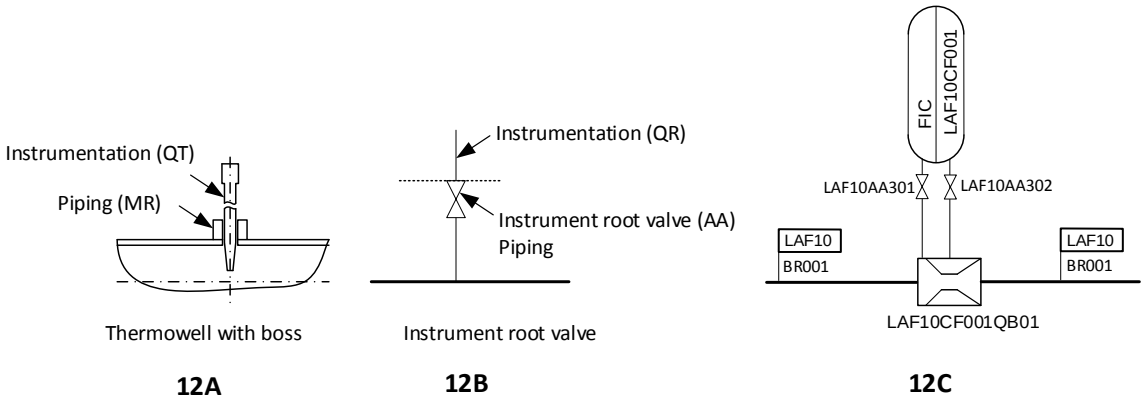


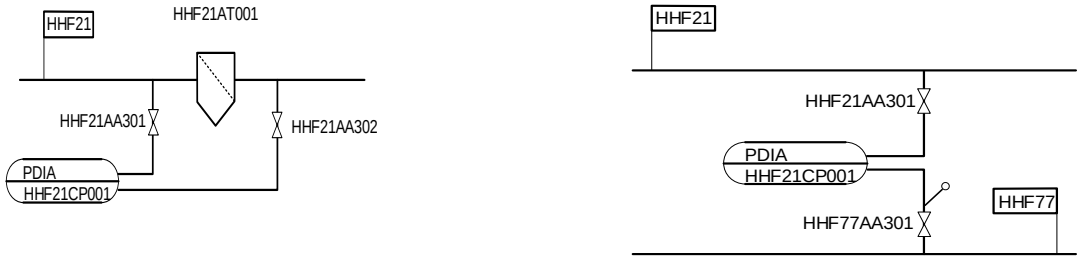
Figure 22 Numbering of piping / instrument interfaces

4.7.2 Differential pressure measurement

Differential pressure measurements include two separate measuring points.

If the measurement is within the same function, transmitter and instrument root valves are numbered in the same function – see Figure 33A.

If the measurement is across two functions, transmitter is numbered in the function with the lowest alphanumeric number. The instrument root valves are numbered in accordance with the functions they branch off from – see Figure 33B



A: Diff. pressure measurement within same function

B: Diff.pressure measurement across two functions

Figure 33 Numbering of differential pressure measurements

5 Representation of reference designation in diagrams

5.1 General

Display of reference designation in process diagrams are described in ISO14084-1. Specific rules for representation of measurement and control are given in ISO 15519-2.

Function and equipment designations must be numbered in the flow direction of the process.

In process diagrams (PID) technical objects shall be represented with reference designation down to equipment level. If an equipment consists of 2 or more components essential for understanding of functionality of the equipment, representation in a detailed PID may be necessary. This rule does not apply for e.g. an electrical operated pump, where it is evident, that electrical motor as component will have a reference designation ending with "-M01"

In typical diagrams (TYD) technical objects shall be represented only with component reference designation.

A reference designation text string shall be a single line and oriented horizontally or vertically corresponding to the reading directions viewed from the bottom edge or viewed from the right-hand edge of the document.

5.2 Reference designation for connections

Representation of reference designation for connections e.g. pipes and ducts, shall be made by using flags – see Figure 14. The "flag" principles is described in ISO 14084-1 Annex D

The pointing direction of the flag indicates the flow direction.

In case of reversible flow, flag type as for GCK10BR001 – see Figure 14 - , shall be used.

The flags shall be placed in the beginning of the connection and at regular intervals

The equipment reference for connections (BRxxx) shall be placed below the flag as illustrated in Figure 14.

5.3 Representation of change of reference designation for connections

Change of functional reference designation for process connections e.g. pipes and ducts in diagrams shall be marked with open pushpins – see figure 14.

Change of equipment reference designation for process connections e.g. pipes and ducts in diagrams shall be marked with closed pushpins – see figure 14.

Rules for design and application of pushpins are given in ISO 14084-1 Annex A.

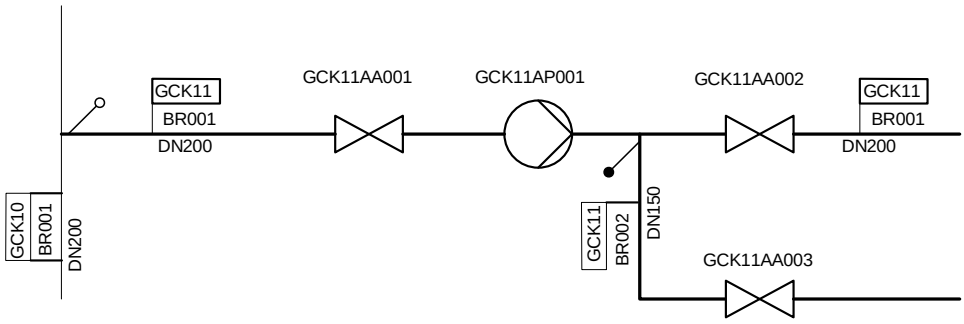


Figure 14 - **Representation of changes of RD for connections in diagrams**

5.4 Reference designation for measuring points

Reference designation for measuring points shall be displayed in the lower part of Process Control Symbols (PCI) as shown in ISO 15519-2. Figure 13 shows application of PCI symbols for measuring points.

5.5 Letter codes for measurement points

Letter codes for measured values and their application in process control are displayed in the upper part of the PCI symbol – see figure 13.

Overview of letter codes for measured variables and for application of measured variables for process control (control functions) are specified in Annex D.

6 Designation of cables

6.1 Numbering system

Cables are numbered with a reference designation system deviating from numbering of process components.

For cable numbering only the unit designation and the alphabetic part of the function designation are used followed by a four digit number, as illustrated in **Figure 4**5.

A/N (ref 1) Letter / digit coding of units. The designation of units within a plant are specified in a separate document

(N) (ref 2) 1-digit coding. Applies only in case of two or more main systems within a unit e.g. two parallel boilers. If not used (N) (ref 2) shall be omitted.

AAA (ref 3) 3-letter coding of functions. The letter codes are defined in a plant specific document

NNNN (ref 4) 4-digit serial numbering according to Table 3

Beak down level	0	1		2
Designation	Unit	Function		Cable number
Alphanumeric characters	A/N	(N)	AAA	NNNN
(Reference)	1	2	3	4

Figure 45 Reference designation structure for cable numbering

Table 3 – Serial numbering of cables

Cable no.	Application	Voltage level
0001 – 0999	Power supply cables	> 1 kV
1001 – 1999	Power supply cables	< 1 kV
2001 – 2999	Measuring cables	> 60 V
3001 – 3999	MCC, coupling relays	< 60 V
4001 – 4999	Interconnecting cables between cabinets	
5001 – 5999	Actuator feedback cables	
6001 – 6999	Cables from junction boxes	
7001 – 7999	Interconnecting cables between cabinets and consoles	
8001 – 8499	- free for use -	
8501 – 8599	Supply cables for solenoids	24 V DC
8601 – 8999	- free for use -	
9001 – 9999	Special cables e.g. bus, network, communication – e.g. fiberoptic and copper	

6.2 Marking of cables

Cable shall be marked with reference designation and type, as specified in GTR-16: Marking and labelling.

6.3 Numbering rules and examples

Following rules apply for numbering of cables:

- Cables between two objects shall be numbered with the function code for the object designated first in the alphabet.
- Power cables between electrical supply systems are numbered according to the power direction.
- Connecting cables to instrument transmitters shall be numbered according to the instrument transmitter.

Examples of cable numbering are given in **Figure 5**6 and Figure 67

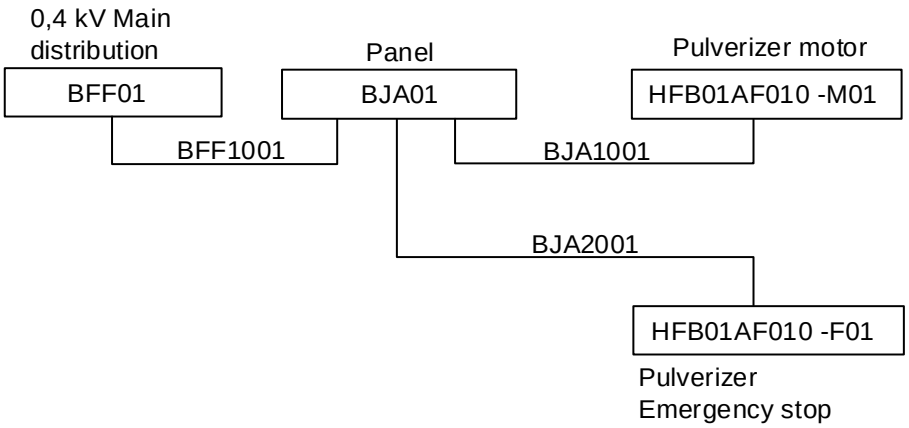


Figure 56 Cable numbering for a pulverizer

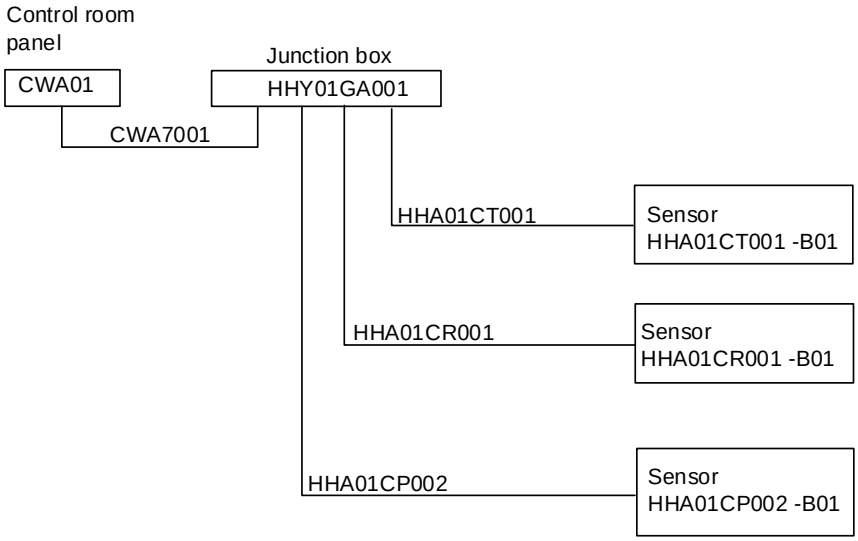


Figure 67 - **Cable numbering for instrument transmitters**

Rules for labeling of cables e.g. specification of information in the label, placement of labels, etc. are given in GTR-16.

7 Designation of signals

Letter codes for numbering of signal designation in the application software are specified in Annex C.

It is an advantage to follow these rules, despite former projects not are consistent in this subject.

8 Creation of denominations

8.1 General

KKS designated objects must be assigned a denomination, which gives a representative description of the main characters of the object.

Denominations must be prepared for use in all plant operation and management systems, where KKS reference designations are used as reference. Examples of operation and management systems, where KKS denominations are used, are e.g. KKS object data bases, documentation data bases, maintenance management systems, screen presentation, component tags, etc.

Correct denomination of KKS designated objects are crucial for the communication within engineering, operation, maintenance in all life cycle phases. Therefore, the creation of denominations for KKS designated objects must be given the utmost attention.

This section specifies rules for creation of denominations for KKS designated objects, which among others include:

- Structuring of text strings
- Length of text strings, text fonts
- Abbreviations
- media designations

8.2 Foreign and Danish suppliers

Denominations shall be in Danish language.

Foreign suppliers may prepare denominations in English language. The denominations shall be without abbreviations.

Employer will translate the English denominations into Danish and return them to Contractor add them to EDH

Supplier shall use Danish denominations in all documentation.

Danish suppliers shall prepare denominations in Danish language following below rules.

8.3 Structuring of text strings

Denominations are composed of four element terms as illustrated in table 4.

It is not mandatory that all elements are represented in a denomination, which appears in table 4.

Table 4 – Elements of a denomination

Element term	Source	Arrangement	Reference	Condition
	PRESSURE	BEFORE	PUMP 21	HIGH

Examples	CHECK VALVE	AFTER	BOOSTERPUMP A	
	TEMPERATURE		HEATER 22	LOW

The four elements are described below:

Source term

The **source term** represents the object / aspect , that the denomination concerns, e.g.

- Physical object, e.g. pump, valve
- Functional object, e.g. controller
- Physical quantity, e.g. pressure, temperature, flow

Arrangement term

The **arrangement term** describes the logic/systematic correlations between the ***source term*** and the ***reference term,*** e.g.

- Suction / pressure side
- Forward / return flow
- Before / after
- Inside / outside

Reference term

The **reference term** is an unambiguous identification of the object to which the **source term concern**

- Physical object e.g. pump, fan, vessel

Condition term

The **condition term** describes the condition / property of the **source term**

- Measured value
- Limit value(min / max, on / off)
- Position (open / closed)

8.4 Maximum length of denominations, text fonts, etc.

The maximum length of a denomination – in Danish language – is 28 characters incl. word spacing.

Denominations shall be with capital letters.

8.5 Abbreviations

The use of abbreviations shall be minimized.

Dots shall be used to identify an abbreviation, when the abbreviation appears inside the text string. If the abbreviation appears as the last text element, the dot must be omitted to safe characters.

Employer has developed an abbreviation library – in Danish - for typical objects / aspects. The purpose of the standardized terms is to avoid abbreviation variants of same object / aspect.

For designation of measured values, the abbreviated designation in table 5 shall be used

Table 5 – Abbreviated designations for measured values

UK Measured variable		UK Abbreviation	UK Unit
	DK Målt art	DK Forkortelse	DK Enhed
Current (electrical)	Strøm (elektrisk)	STR	A
Voltage (electrical)	Spænding (elektrisk)	SP	V
Resistance (electrical)	Modstand (elektrisk)	MODST	ohm
Power (electrical)	Effekt (elektrisk)	EFFEKT	W
Energy (heat)	Effekt (varme)	EFFEKT	J/s
Flow	Flow	FLOW	kg/s el. Nm3/h
Speed	Hastighed	HAST	m/s
Temperature	Temperatur	TEMP	°C
Pressure gauge	Tryk overtryk	TRYK	barg
Pressure absolute	Tryk absolut	TRYK	bara
Pressure difference	Differenstryk	DIFTR	bar
Level	Niveau	NIVEAU	mm
Vibration (absolute)	Vibration (absolut)	VIBRA	mm/s
Vibration (relative)	Vibration (relativt)	VIBRA	µm
Expansion (thermal)	Ekspansion	EKSPA	mm
Salinity	Ledningsevne	LDEV	µS/cm
Particles	Partikel indhold	PARTIND	ppm
Carbon monoxide	Kulite	CO	% CO
Carbon dioxide	Kultveilte	CO_2	% CO_2
Acidity	Surhedsgrad	SURHGR	Ph
Oxygen	Iltindhold	O_2	% O_2
Speed	Omdrejninger	OMDR	o/min
Frequence	Frekvens	FREKV	Hz
Position (binary)	Position (binær måling)	POS	-
Position (analogue)	Stilling (analog måling)	STIL	%

Annex A Letter codes and numbering of equipment

A.1 Letter codes for equipment

A Mechanical equipment

(Components, which through movement or function influences the process)

AA Valves, dampers, blinds including actuators, also manually operated valves

AB Doors, sluices, etc. including drives

AC Heat exchangers, heat transfer surfaces (se also AH)

AD Not for use

AE Turning, driving, lifting and slewing gear (also manipulators)

AF Conveyors, feeders, escalators

AG Generator units

AH Heating, cooling and air conditioning units with integrated motors (see also AC)

AJ Size reduction equipment, e.g. mills, grinders

AK Compacting and packaging equipment for solid media

AL Not for use

AM Mixers, agitators

AN Compressor units, fans, suction devices of all media except liquid media (see also AP)

AP Pump units for liquid media (see also AN)

AS Adjusting and tensioning equipment

AT Extractors, cleaning, filtering, drying and separating equipment, e.g. soot blowers, shot cleaning system incl. steam traps, air release valves

AU Converters, e.g. electro-hydraulic convertion gear, Voith gear (non electrical)

AV Burners and other burner equipment, e.g. grates

AW Stationary tooling, treatment equipment

AX Test and monitoring equipment, e.g. a television, and carbon sampling device (not measuring circuits)

AZ Special units

B Mechanical equipment

(Components in which the process takes place, is being stored or transported, and the carrying parts)

BB Storage equipment, (tanks, vessels, condensing pots, standpipes, etc.)

BE Shafts (only for erection and revision)

BF Foundations

BH Cooling and heating devices (not driven), e.g. heaters, cooling elements, steam heating of oil tanks, el-tracing etc.

BN Ejectors, injector nozzles

BP Throttle orifice, flow restrictors, limiters,
orifices (not metering orifices). Burst discs, flame - and explosion arrestors

BQ Hangers, supports, racks, piping penetrations

BR Piping, ductwork, chutes, compensators, joints

BS Silencers

BT Flue gas catalytic converter modules

BU Insulation, sheathing

BY Controller

BX Viewing glass

BZ Special devices

C Direct measuring circuits

CA Electric voltage

CC Electric current

CD Density

CE Electric or electromagnetic variables (others than CA and CC)

CF Flow

CG Position, direction of rotation, distance, eccentricity, expansion

CH Human observation

CJ Power, energy

CK Time

CL Level

CM Moisture, humidity

CP Pressure

CQ Quality measuring (pH-value, conductivity, viscosity, etc.)

CR Radiation (radiation, light, nuclear, e.g. flame supervision)

CS Velocity, frequency (mechanical), speed, acceleration,

CT Temperature

CU Combined variables

CW Weight, mass

CY Vibration

D Closed loop control circuits

DA Electric voltage

DC Electric current

DD Density

DE Electric or electromagnetic variables, others than DA and DC

DF Flow

DG Position, direction of rotation, distance, eccentricity, expansion

DH Human observation

DJ Power, energy

DK Time

DL Level

DM Moisture, humidity

DP Pressure

DQ Quality measuring (pH-value, conductivity, viscosity, etc.)

DR Radiation (heat radiation, light, nuclear, e.g. flame supervision)

DS Velocity, frequency (mechanical), speed, acceleration, vibration

DT Temperature

DU Combined variables

DW Weight, mass

DY Vibration

E Measuring value and signal conditioning (control blocks etc.)

EA General overall control

EB Group control

EC Sequence control

EG Unit control

EM EDP-CRT screen, terminal, TV camera

EN EDP printer

EP EDP - CPU

EQ EDP-magnet tape, cassette

ER Reactor protection

EU Combined measuring value and signal conditioning

EW Protection

F Indirect measuring circuits

FA Electric voltage

FC Electric current

FD Density

FE Electric or electromagnetic variables, others than FA and FC

FF Flow

FG Position, direction of rotation, distance, eccentricity, expansion

FH Human observation

FJ Power, energy

FK Time

FL Level

FM Moisture, humidity

FP Pressure

FQ Quality measuring (pH-value, conductivity, viscosity, etc.)

FR Radiation (radiation, light, nuclear, e.g. flame supervision)

FS Velocity, frequency (mechanical), speed, acceleration, vibration)

FT Temperature

FU Combined variables

FW Weight, mass

FY Vibration

G Electrical equipment

GA Binary junction boxes (passive components)

GB Analogue junction boxes (passive components)

GC Combined junction boxes (passive components)

GD Junction boxes

GE Junction boxes

GF Junction boxes, general

GG Junction boxes, (penetrations, cables)

GH Built-in units - as per process system (boxes for EL/DCS, larger E-motors)

GK Information display and operator control equipment for process computers and automation systems

GM Junction boxes for telecommunication services

GP Junction box for lighting

GQ Junction box/power sockets

GR Batteries

GS Box or panel including active components (switches), local operating box, local signal processing devices

GT Transformers

GU Converters

GV Structure-related earthing and lighting protection for buildings, overvoltage protection isolators, earthing, circuit breakers

GW Cabinet power supply equipment

GX Actuating equipment for electrical variables

GY Junction boxes for light-current systems (not of telecommunication services)

H Main and heavy machinery
(only in connection with function main groups M and X)

HA Machine stationary assembly

HB Machine rotating assembly

HD Bearing assembly

A.2 Numbering of equipment

A.2.1 Valves, dampers, etc. with letter code AA

AA001 – AA199	Valves, dampers for main piping and ducting
AA201 – AA249	Valves in drain and flushing piping
AA250 – AA299	Valves in venting piping
AA301 – AA399	Valves for measurement points, instrument root valves
AA401 – AA449	Valves for sampling extraction to analyser
AA450 – AA499	Valves for chemical dosing
AA501 – AA599	Valves for test functions
AA601 – AA699	Valves for tracing
AA701 – AA999	Valves for special purposes

A.2.2 Numbering of measurement points

001 – 199	Analogue and binary measurements to central control system (DCS)

201 – 299	Analogue and binary measurements to local control system, devices with signal processing e.g. flow and energy meter
301 – 399	Analogue and binary measurements with local instruments for visual value reading
401 – 499	Free for use
501 – 599	Gradient and material temperature measurements
601 – 699	Test measuring points
701 – 799	Free for use
801 – 899	Combined measurements for environment measurements
901 – 999	Combined or calculated measurements

Annex B: Letter codes for components

B.1 Mechanical components type "K"

KA Gate valves, globe valves, dampers, taps, rupture disks, orifices

KB Gates, doors, dam boards

KC Heat exchangers, coolers

KD Vessels/tanks, pools, surge tanks (fluid systems)

KE Turning, driving, lifting and slewing gear

KF Continuous conveyors, feeders

KG Flanges, connections

KH Heat pumps

KJ Size reduction machines

KK Compacting, packaging machines

KM Mixers, agitators

KN Compressors, blowers, fans

KP Pumps

KT Cleaning machines, dryers, separators, filters

KU Power converters

KV Burners, grates

KW Stationary tooling and treatment machines for maintenance

KX Stationary testing and supervision devices (inspection glass, inspection hole)

KZ Special components

B.2 Mechanical components type "M"

MB Brakes

MF Foundations

MG Gear boxes

MK Clutches, couplings

MM Motors, non-electrical

MR Piping components, ductwork components

MS Actuators non-electrical

MT Turbines

MU Transmission gear, non-electrical, converters and boosters other than couplings and gearboxes

B.3 Instrumentation and control components – non-electrical

QB Sensors if not structurally integral with *QP*, e.g. metering orifices

QH Signalling devices

QN Controllers, flybolt governor

QP Measuring instruments, testing equipment

QR Instrument piping

QS Condensation chambers (datum reservoir) in measuring circuits

QT Thermowells and pockets for protection of sensors

QU Converters (non-electrical)

B.4 Electrical components

- A Assemblies and subassemblies
- B Transducers for non-electrical to electrical values and vice versa
- C Capacitors
- D Binary elements, delay devices, memory devices
- E Lighting- and heating components, coolers etc., electrical heat tracing
- F Protective devices, fuses, limit switches
- G Generators, power supplies
- H Signalling devices
- J Mechanical devices for electrical equipment, cables, etc.
- K Relays, contactors
- L Inductors
- M Motors
- N Amplifiers, controllers, frequency converters
- P Measuring instruments, testing equipment
- Q Power switchgear
- R Resistors
- S Switches, selectors
- T Transformers
- U Modulators, convertors from electrical to other electrical variables
- V Tubes, semiconductors
- W Transmission paths, waveguides, aerials
- X Terminals, plugs, sockets
- Y Electrical positioners, e.g. solenoids (not motors)

- Z Terminations, balancing equipment, filters, limiters, cable terminations, equalizers, hybrid transformers

Annex C: Signals

C.1 Signal main groups

X Signals to DCS (inputs)

Y Signals from DCS (outputs)

Z Combined signals

C.2 Signal origins (input values HW & SW) – type "X"

XA Automatic signal / function group

XB Single unit control

XC Open loop control (analogue)

XG Limit values, binary (contacts)

XH High and low limit value, from an analogue signal

XJ Analogue signals (from e.g. measurements)

XL Low and high limit value, from analogue signal

XM System acknowledge signals

XN Binary acknowledge signals

XP Process computer

XQ Analogue signals (from e.g. measurements)

XR Controller signals analogue

XS Sequence step number

XT Discharge signals

XU Combined signals

XV Fail Safe signals

C.3 Automatic signal / function group – type "XA"

XA01 Unit Switch Over On/Running

XA02 Unit Switch Over Off/Stopping

XA03 Unit Switch Over in Automatic

XA04 Unit Switch Over in Manual

XA05 Start-program selected

XA06 Stop-program selected

XA07 Start-program Running

XA08 Stop-program Running

XA11 Start signal for Sequence control
XA12 Stop signal for Sequence control
XA21 Equipment 1 start command
XA22 Equipment 2 start command
XA23 Equipment 3 start command
XA24 Equipment 4 start command
XA31 Equipment 1 Selected
XA32 Equipment 2 Selected
XA33 Equipment 3 Selected
XA34 Equipment 4 Selected
XA41 Equipment 1 stop command
XA42 Equipment 2 stop command
XA43 Equipment 3 stop command
XA44 Equipment 4 stop command
XA50 Error
XA51 Unit Switch Over not ON
XA52 Unit Switch Over not OFF
XA53 Unit Switch Over not in Auto
XA54 Unit Switch Over not in Manual
XAnn Automatic signals free for use

C.4 Single drive control / Electrical-Valves / Motors – type "XB"

XB01 Drive control On / Open
XB02 Drive control Off / Closed
XB03 Drive control in auto
XB04 Drive control in manual
XB05 Drive control run Open / Direction 1
XB06 Drive control run Close / Direction 2
XB07 Drive control/Frequency converter ready
XB08 Drive control/Frequency converter error
XB09 Drive control stopped
XB10 Check back in Test position
XB11 Torque opening
XB12 Torque closing

XB16 Feedback Local operation
XB17 Feedback Remote operation
XB39 Feedback Thermal trip
XB49 Feedback Fault (common)
XB51 Feedback NOT STARTED/OPEN
XB52 Feedback NOT STOPPED/CLOSED

C.5 Controller – type "XC"

XC01 Valve/Damper open (100 %)
XC02 Valve/Damper close (0 %)
XC03 Valve/Damper in Automatic mode
XC04 Valve/Damper in Manual mode
XC05 Valve/Damper error
XC06 Torque in opening
XC07 Torque in closing
XC08 Remote control on
XC09 Local control on
XC10 Controller Auto up
XC11 Controller Auto down
XC13 Controller in Automatic
XC14 Controller in Manual
XC27 Command open
XC28 Command close
XC37 Emergency open
XC38 Emergency close
XC47 Release open
XC48 Release Close
XC51 Valve/Damper not open
XC52 Valve/Damper not closed

C.6 Binary transmitters / Contacts – type "XG"

XG01 NO/NC contact, >MIN
XG02 NO/NC contact, >MAX
XG51 NO/NC contact, <MIN

XG52 NO/NC contact, <MAX

C.7 Limit switches created from analogue signals – type "XH"

XH01 Limit Value greater than, >High1
XH02 Limit Value smaller than, >Low1
XH03 Limit Value greater than, >High2
XH04 Limit Value smaller than, >Low2
XH05 Limit Value greater than, >High3
XH06 Limit Value smaller than, >Low3
XH07 Limit Value greater than, >High4/MAX
XH08 Limit Value smaller than, >Low4/MIN
XH51 Limit Value NOT greater than, >High1
XH52 Limit Value NOT smaller than, >Low1
XH53 Limit Value NOT greater than, >High2
XH54 Limit Value NOT smaller than, >Low2
XH55 Limit Value NOT greater than, >High3
XH56 Limit Value NOT smaller than, >Low3
XH57 Limit Value NOT greater than, >High4/MAX
XH58 Limit Value NOT smaller than, >Low4/MIN

C.8 Limit switches created from analogue signals – type "XL"

XL01 Limit Value lower than Low 1
XL02 Limit Value lower than Low 2
XL03 Limit Value lower than Low 3
XL04 Limit Value lower than Low 4
XL11 Limit Value lower than MIN
XL51 Limit Value NOT lower than low 1
XL52 Limit Value NOT lower than low 2
XL53 Limit Value NOT lower than low 3
XL54 Limit Value NOT lower than low 4
XL61 Limit Value NOT lower than MIN

C.9 System acknowledge – type "XM"

XM01 Torque blocking opening

XM02 Torque blocking closing
XM03 Run time error
XM04 Position error valve/Damper
XM05 Run-time error opening
XM06 Run-time error closing
XM07 Position error open
XM08 Position error closed
XM11 Tip control 1
XM12 Tip control 2
XM13 Tip control 3
XM14 Tip control 4
XM26 Analogue signal OK
XM28 Binary signal OK
XM29 Operator blocked
XM41 External error
XM42 General error
XM46 Error
XM47 position control error
XM50 1 out of N error
XM51 2 out of N error
XM60 Correction calculation error
XMnn System check from DCS system

C.10 Binary signals – type "XN"

XN07 Position error open local
XN08 Position error closed local
XN17 Position error open from emergency action
XN18 Position error close from emergency action
XNnn Binary Signals free for use

C.11 Analogue value – type "XQ"

XQ01 Analogue measurement
XQ41 Operating time
XQ42 Amount counter

XQ43 Time mean value

XQ44 Electric work

C.12 Sequence control – type"XS"

XS010 Step 010 in Start-Sequence

XS020 Step 020 in Start-Sequence

XS030 Step 030 in Start-Sequence

XS040 Step 040 in Start-Sequence

XS050 Step 050 in Start-Sequence

XS060 Step 060 in Start-Sequence

XS070 Step 070 in Start-Sequence

XS080 Step 080 in Start-Sequence

XS090 Step 090 in Start-Sequence

XS100 Step 100 in Start-Sequence

XS490 Step 490 - last step in Start-Sequence. The Function Group is IN

XS510 Step 510 in Stop-Sequence

XS520 Step 520 in Stop-Sequence

XS530 Step 530 in Stop-Sequence

XS540 Step 540 in Stop-Sequence

XS550 Step 550 in Stop-Sequence

XS560 Step 560 in Stop-Sequence

XS570 Step 570 in Stop-Sequence

XS580 Step 580 in Stop-Sequence

XS590 Step 590 in Stop-Sequence

XS600 Step 600 in Stop-Sequence

XS990 Step 990 - last step in Stop-sequence. The Function Group is OUT

XSnn Step nnn in Sequence control

C.13 Combined signals – type "XU"

XU01- Free to use

XU99 Free to use

C.14 FAIL SAFE signals – type "XV"

XV01- Free to use

XV99 Free to use

C.15 Signal origin (output values HW & SW) – type "Yx"

YA Automatic

YB Single unit control

YC Regulation

YG Limit values, binary (contacts)

YH Limit values, analogue

YJ Analog values - regulation

YL Desks and tables

YM Fault signals

YP Process computer

YQ Analog signals

YU Combined signals

YV Fail Safe signals

C.16 Main group Y - signal key

YA Automatic

YB Single unit control

YB01 Command START/IN/OPEN/FORWARD

YB02 Command STOP/OUT/CLOSE

YB03 Command RELEASE LOCAL

YB04 Command DISP.

YB05 Command DISP.

YB06 Command RESET/ACKNOWLEDGE

YB11 Command Emergency START/ IN / OPEN

YB12 Command Emergency STOP / OUT / CLOSE

YB21 Command Release ON for START/ IN/ OPEN

YB22 Command Release ON for STOP/ OUT/ CLOSE

YC Controller signals

YC11 Controller output 0 - 100 %

YG Limit values, binary (contacts)

YH	Limit values, analogue
YJ	Analog values - regulation
YM	Fault signals
YQ	Analog signals (0 - 100 %)

Annex D Letter codes for process variables and control functions

Letter codes for process variables and control functions are based on ISO 15519-2, with following additions:

Process variables	N	Power output (heat)
	Y	Vibration
Modifiers	Q	Summation

	Process variable	Modifier	Control functions	Modifier
A	Electric voltage		Alarming, message [20]	
B				
C	Electric current		Control (closed loop control)	
D	Density	Difference [11]		
E	Electric or electromagnetic variables (except A and C) [1]			
F	Flow rate			
G	Distance, position or length			
H	Human observation [2]			High [30]
I	Not to be used		Indicating	
J	Power, energy			
K	Time			
L	Level [3]			Low [31]
M	Moisture, humidity			
N	Power output (heat)			
O	Not to be used			
P	Pressure, vacuum [3]	Test point [12]		
Q	Quality [4]	Summation		
R	Radiation [5]		Recording	
S	Speed, frequency [6]		Switching (open loop control)	
T	Temperature			
U	Multivariable [7]			
V				
W	Weight, force			
X				
Y	Vibration			
Z	Number of events, quantity [8]		Switching (open-loop) Safety / protection relevant [21]	

[1] E.g. resistance, impedance, inductance.

[2] Based on one or more human sensory systems

[3] When a differential pressure measurement is used for level measurement then letter code L shall be used and not P.

[4] The measured variable shall be indicated outside the circle, specifying the type of quality, e.g. pH-value, purity, conductivity, material property, viscosity, etc.

[5] Radiation, light, nuclear

[6] Including vibration, rotary speed.

[7] The generated variable shall be indicated outside the circle specifying the type of multivariable, e.g. general alarm, enthalpy, pH, µS

[8] The letter Z as measured variable shall be used when control or monitoring responses are event-driven as opposed to time or time schedule-driven. The letter may also signify presence or state.

[11 Indication of that the measurement represents the difference of two measurements, e.g. differential pressure over a filter

[12] Indication of a not used measuring point, to which it is possible to connect a temporary measuring device, e.g. pressure transmitter.

[20] Shall only be used for separate alarm control functions. If control functions S and Z at time of action also trigger an alarm / message, then the A must not be used in addition to the in front letter codes S or Z

[21] A control function to be realized by a safety instrumented function according to IEC 61511-1 or an equipment protection system, when an acknowledgement is specified to enable a restart

[30] Indication of that the measured value is high compared to low. The modifier can be differentiated by doubling or tripling e.g. HH -Very high, HHH - Extremely high.

[31] Indication of that the measured value is low compared to high, The modifier can be differentiated by doubling or tripling e.g. LL - Very low, LLL - Extremely low.