Tool identification system

The standard from Liebherr

LIEBHERR

Liebherr-Verzahntechnik GmbH

1 Basics

Liebherr-Verzahntechnik GmbH can implement any tool identification system according to the customer's requirements and configure the data which is saved on the data storage media. For custom hardware and software solutions, however, this always involves additional work that must be specifically assessed.

Compared to these customer-specific solutions, this document describes the more cost-effective Liebherr standard solution.

2 Hardware requirements

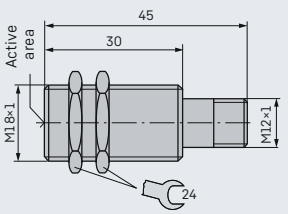
The following requirements apply for installation and execution of the function:

- Balluff RFID system consisting of:
  - Evaluation unit: BIS C-6008-048-650-06-ST23 BIS00K
  - Read-write head: BIS C-300-PU1-10 BIS00P6
  - Handle: BIS C-300-HG1 BAM012A

- Tool holders on which a Balluff code carrier is mounted:
  - Code carrier: BIS015W (1023 Byte)

Read/write head
BIS C-325/_ _-S4

Dimensions
when ordering:
Cable length _ _
01 = 1 m
05 = 5 m
10 = 10 m
Appropriate connection cables[2]



Distances and speeds between the read/write head and suitable data medium

Appropriate data medium		Static operation (V=0)								Dynamic operation (V>0)		
		Distance [mm]		Offset in (mm) at distance in (mm) of						Distance [mm]	Vmax. [m/min][1]	
		Read	Write	0.7	1	3	5	7	10		Read	Write
Flush [3]	BIS C-100-05/A	0 to 4	0 to 4		± 3.5	± 3				1	9	5
	BIS C-122-_ _/L	0 to 2.5	0 to 2.5		± 2.5					1	6	4
	BIS C-121-04/L-SA1	0 to 1.7	0 to 1.7	± 2	± 2							
Not flush	BIS C-130-05/L	0 to 4	0 to 4		± 4	± 2				0 to 5	6 to 3	4 to 2
	BIS C-130-05/L-SA1	0 to 3	0 to 3		± 4	± 2				0 to 5	6 to 3	4 to 2
	BIS C-130-05/L-SA2	0 to 3.5	0 to 3		± 4	± 3				1	6	4
	BIS C-191-_ _/L	0 to 2.5	0 to 2.5		± 4	± 3				1	6	4

[1] Relative speed when reading or writing the first 4 bytes (bytes 0...3).
[2] BIS C-505-PU-_ _ / BIS C_506-PU-_ _ / BIS C-517-PVC-_ _ / BIS C-518-PVC-_ _
[3] With flush installation in steel.

Fig. 2.1: Distances between code carrier and evaluation unit

3 Attaching the code carrier to the tools

Balluff BIS015W code carriers can be used for the tool identification system. These must be attached to the tool holder as specified by Liebherr for each holder type, see example in picture 3.1.

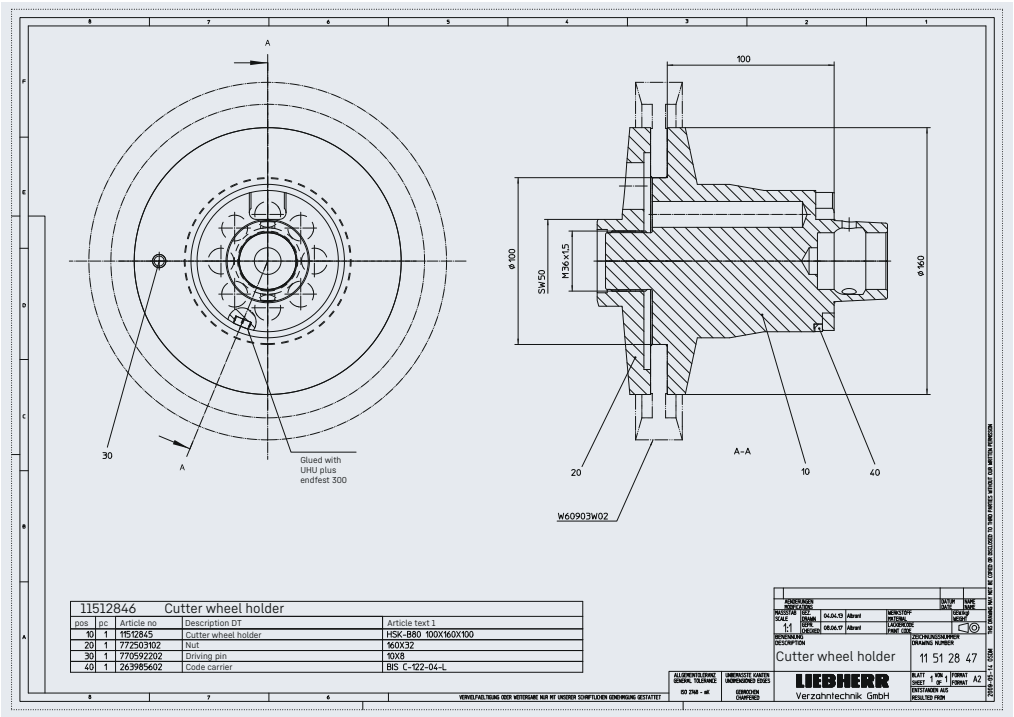


Fig. 3.1: Position for attaching the tool holder on an HSK-B80 holder

4 Liebherr standard data structure on the code carriers

The data is written on the code carrier as a binary structure, with numerical values saved in Little Endian format. Because the data capacity of the code carrier is not known when reading/writing (e.g. BIS_C), the header data is always read or written before the payload data. The header contains at least the number of header data and payload data (i.e. at least 4 bytes):

Header data

Name	Start (offset)	Data type	Description
HeaderSize	0x0000	UINT16	Number of header data (at least 4)
PayloadSize	0x0002	UINT16	Number of payload data (tool data)

The payload data (tool data) directly follows the header data. The definitions of the individual tools have different structures depending on their type. The data is always saved as a tuple (variable / length of data type / value). Each variable has a globally unique ID of the UINT8 type. The length is saved as an unsigned byte (UINT8) and defines the number of bytes used. The tuples are written in sections onto the code carrier. The first section always contains the data relating to the entire, assembled tool. The subsequent sections then refers to the individual tools mounted on it, i.e.:

- Data of the assembled tool
  - Data individual tool 1
  - Data individual tool 2
  - Data individual tool 3

The order of the individual tools does not have to correspond to the geometric arrangement on the tool holder.

No information concerning the spacer rings are recorded.

All data stored on the code carrier must be written in the metric format.

The data tuples within a section can be in any order. LHGearTec always reads all the data from the code carrier, but does not process entries that it does not need or does not know (for example, if the code carrier has been written with extended data by a newer version of LHGearTec).

When writing, the entire previously read data record (including the unprocessed data) is written back. Data fields that did not exist in the original data record are not added. Therefore if the memory limit of the code carrier is reached, the same number of individual tools can no longer be written to the code carrier. If the complete data on the LHGearTec version is to be written to the code carrier (i.e. with all new data that may have been added), it has to be done explicitly by user intervention.

The data tuples are defined as follows:

Assembled tool

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Arbor tool name	–	–	0x02	CHAR[32]	UTF8	–
Assembled tool name [1]	–	–	0x03	CHAR[32]	UTF8	–
Arbor diameter	TArbCollDia	–	0x04	FLOAT32	[1 : ...]	mm
Flange diameter on arbor side	TArbCollDia_2	–	0x05	FLOAT32	[1 : ...]	mm
Arbor shank length	TArbCollLen	–	0x06	FLOAT32	[0 : ...]	mm
Arbor version	TArbDesign	–	0x07	UINT8	0=hole tool 1=shank tool	Anzahl
Tool mounting diameter	TArbDia	–	0x08	FLOAT32	[5 : ...]	mm
Mounting length	TArbLen	–	0x09	FLOAT32	[10 : ...]	mm
Arbor position for use	TArbLocOfUse	–	0x0A	UINT8	3=opposite operator side 6=loading position 9=operator side 12=machining position	–
Main bearing shank angle	TArbShaAng	–	0x0B	FLOAT32	[0 : ...]	deg
Arbor clamping diameter	TArbShaDia	–	0x0C	FLOAT32	[1 : ...]	mm
Arbor clamping length	TArbShaLen	–	0x0D	FLOAT32	[1 : ...]	mm
Total arbor length	TArbTotLen	–	0x0E	FLOAT32	[0 : MLimToolShaLenMax]	mm
Grinding material	TAbrasive	–	0x0F	UINT8	0 = undefined 1 = CBN 2 = CBN dressable 2 = free definition 40 = corundum 40 50 = corundum 50 63 = corundum 63 80 = corundum 80 100 = corundum 100	–

Single Tool (Base Data)

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Tool name [1]	–	–	0x01	CHAR[32]	UTF8	–
Tool type	TTyp	–	0x65	UINT16	see Tabelle 4.3	–
Tool coating	TCoating	–	0x29	UINT8	0 = TiAlN 1 = AlCrN 2 = TiN 3 = TiCn 4 = uncoated	–
Crossed-axis angle tracking	TCroAxisAngActive	–	0x2A	UINT8	[0 : 1]	–
Crossed-axis angle in new condition	TCroAxisAngNew	–	0x2B	FLOAT32	[-30 : 30]	deg
Crossed-axis angle in new condition	TCroAxisAngUseHt	–	0x2C	FLOAT32	[-30 : 30]	deg
Tool version	TDesign	–	0x36	UINT8	0 = hole tool 1 = shank tool	–
Tool rotating direction	TDirRot	–	0x39	INT8	+1 = clockwise -1 = anticlockwise	–
Tool status	TState	–	0x5A	UINT8	0 = undefined 1 = blank 2 = roughly profiled 3 = finely profiled	–
Tool substrate	TSubstrate	–	0x5B	INT8	-1 = undefined 0 = PM_HSS 1 = HSS 2 = HM 3 = HM_WSP	–
Inspection record number	TInsNr	–	0x47	CHAR[32]	UTF8	–

Single Tool (Geometry)

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Flange width (left)	TAdaLenLeft	–	0x10	FLOAT32	[0 : ...]	mm
Flange width (right)	TAdaLenRight	–	0x11	FLOAT32	[0 : ...]	mm
Pressure angle left flank (skiving cutters only)	TAlfa0_LF		0x12	FLOAT32	[0 : ...]	deg
Pressure angle right flank (default)	TAlfa0_RF	α0	0x13	FLOAT32	[0 : ...]	deg
Number of individual tools	TAmount		0x14	INT32	[0 : ...]	–
Area length	TAreaLen		0x15	FLOAT32	[0 : ...]	–
Area name	TAreaName		0x16	CHAR[32]	UTF8	–
Start of area (from main bearing side)	TAreaStr		0x17	FLOAT32	[0 : ...]	–
Normal module	TMn0	mn0	0x4B	FLOAT32	[0 : ...]	–
Normal module of the corresponding gear	TMn2	mn2	0x4C	FLOAT32	[0 : ...]	–
Axial module	TMx0	mx0	0x4F	FLOAT32	[0.1 : MLimMNGenWormMax]	–
Number of starts on the tool	TZ0	z0	0x6A	UINT8	[0 : 255]	–

Single Tool (Geometry)

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Number of teeth (effective)	TZ0eff	zeff	0x6B	UINT8	[2 : 255]	–
Number of starts on the corresponding gear	TZ2	z2	0x6C	UINT8	[0 : 255]	deg
Tip circle entry variant	TDA0Typ	–	0x32	UNIT8	see Tabelle 4.4	–
Lead angle	TGamma0	γ0	0x42	FLOAT32	[- … : …]	deg
Lead	TLead	H0	0x49	FLOAT32	[0 : …]	mm
Number of gashes	TI0	–	0x46	UNIT8	[0 : 255]	–
Addendum	THaP0	haP0	0x44	FLOAT32	[0 : …]	–
Addendum coefficient	THaP0x	haP0*	0x45	FLOAT32	[0 : …]	–
Tooth thickness	TToothThi	sP0	0x61	FLOAT32	[0 : …]	mm
Tooth shape type	TToothTyp	–	0x62	UINT8	1=involute 2=non-involute 3=asymmetric 4=slot	
Outside diameter – nominal	TDA0	da0	0x2E	FLOAT32	[0 : …]	mm
Overall length	TTotLen	–	0x63	FLOAT32	[0 : …]	mm
Cutting edge length	TCutLen	–	0x2D	FLOAT32	[0 : …]	mm
Helix angle of tool	TBeta	β0	0x19	FLOAT32	[-45 : 45]	deg
Bore diameter	TBore	–	0x1A	FLOAT32	[1 : TDA0]	mm
Width for shaping and skiving tool	TClmWidth	–	0x1B	FLOAT32	[- … : …]	mm
Base diameter on left of pre-profiled worm	TDb0_LF	db0	0x33	FLOAT32	[- … : …]	mm
Base diameter on right of pre-profiled worm	TDb0_RF	db0	0x34	FLOAT32	[- … : …]	mm
Root diameter of a pre-profiled worm	TDf0	df0	0x37	FLOAT32	[- … : …]	mm
Minimum root diameter of a pre-profiled worm	TDf0Min	df0	0x38	FLOAT32	[MLimDA0Min : MLimDA0Max]	mm
Distance, main bearing ↔ tool beginning	TDisMaiBea	–	0x3A	FLOAT32	[0 : …]	mm
Distance, main bearing ↔ tool center	TDisMaiBeaCen	–	0x3B	FLOAT32	[- … : …]	mm
Datum diameter	TDm0	–	0x3E	FLOAT32	[- … : …]	mm
Dimension for orientation of a pre-profiled worm	TEtaDelta	–	0x3F	FLOAT32	[- … : …]	deg
Dimension for base space angle of a pre-profiled worm	TEtaSigma	–	0x40	FLOAT32	[- … : …]	deg
Hand of thread	TLeadDir	–	0x49	INT8	+1=positive lead -1=negative lead	–
Outer rake face diameter	TOutClmFaceDia	–	0x51	FLOAT32	[1 : TDA0]	mm
Rake angle	TRakAng	η0	0x52	FLOAT32	[- … : …]	deg
Lead angle of the rake face (rake face lead angle)	TRakFacLeadAng	τ0	0x53	FLOAT32	[-45 : 45]	deg
Rake face offset	TRakFacOff	–	0x54	FLOAT32	[0 : …]	mm
Recess diameter	TRecess	–	0x55	FLOAT32	[1 : TDA0]	mm
Swivel angle A-axis	TSwiAng	η	0x5B	FLOAT32	[-40 : 45]	deg

Worm wheel hob, tapered

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Taper angle	TTapAng	–	0x5C	FLOAT32	[- ... : ...]	deg
Taper length	TTapLen	–	0x5D	FLOAT32	[- ... : ...]	mm
Approach area	TTapSec	–	0x5E	FLOAT32	1 = left 2 = right	–

Skiving and shaper cutter

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Functional direction	TTypDir	–	0x66	UINT8	0 = pushing 1 = pulling	–
Usable height	TUseHt	h4	0x67	FLOAT32	[... : TCutLen]	mm
Addendum modification coefficient	TX0	x	0x68	FLOAT32	[-2 : 2]	–
Addendum modification	TXm0	xm0	0x69	FLOAT32	[- ... : ...]	mm

Wear

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Number of produced parts	TCntWp	–	0x28	UINT16	[0 : ...]	–
Outside diameter – current	TDA0Cur	–	0x2F	FLOAT32	[0 : ...]	mm
Outside diameter – maximum	TDA0Max	da0	0x30	FLOAT32	[0 : ...]	mm
Outside diameter – minimum	TDA0Min	da0	0x31	FLOAT32	[0 : ...]	mm
Shift-position – current	TShiPosCur	–	0x59	FLOAT32	[MDPosLimMinus1_V1 : MDPosLimPlus1_V1]	mm

Bad tool sectors

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Bad sectors [2)]	TBadSecNum	–	0x18	INT32	[0 : MBadSecNum]	–
Begin bad sector 1	TBadSecStr	–	0x18	FLOAT32	[0 : ...]	mm
End bad sector 1	TBadSecEnd	–	0x18	FLOAT32	[0 : ...]	mm
...	...	...	...	...	...	...
Begin bad sector 31	TBadSecStr	–	0x18	FLOAT32	[0 : ...]	mm
End bad sector 31	TBadSecEnd	–	0x18	FLOAT32	[0 : ...]	mm

Reference tooth

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Referenzzahn vorhanden	TRefTooth	–	0x55	UINT8	0: Nicht vorhanden 1: Vorhanden	–
Distance to tool begin	TRefToothDis	–	0x56	FLOAT32	[0 : ...]	mm
Angular position	TRefToothPosB	–	0x57	FLOAT32	[0 : 360]	deg

Chamfern

Designation	Parameter name	Sym.	ID	Type	Area/code	Unit
Chamfer angle left flank	TCmfAng_LF	δF	0x1C	FLOAT32	[-... : ...]	deg
Chamfer angle right flank	TCmfAng_RF	δF	0x1D	FLOAT32	[-... : ...]	deg
Center distance, nominal	TCmfCdNom	a	0x1E	FLOAT32	[-... : ...]	mm
Chamfer depth left flank	TCmfDepth_LF	tFL	0x1F	FLOAT32	[-... : ...]	mm
Chamfer depth right flank	TCmfDepth_RF	tFR	0x20	FLOAT32		mm
Gearing edge to be deburred	TCmfLocOfUse	–	0x21	UINT8	0 = undefined 1 = top 2 = middle 3 = bottom	–
Minimum center distance without material removal	TCmfMinCdAuto	w	0x22	FLOAT32	[MDPosLimMinus1_X1 : MDPosLimPlus1_X1]	mm
Minimum center distance without contacting surface	TCmfMinCdJog	v	0x23	FLOAT32	[MDPosLimMinus1_X1 : MDPosLimPlus1_X1]	mm
Stock of finish-machining	TCmfStockFin	–	0x24	FLOAT32	[-... : ...]	mm
Stock of finish-machining left flank	TCmfStockFin_LF	–	0x6D	FLOAT32	[-... : ...]	mm
Stock of finish-machining right flank	TCmfStockFin_RF	–	0x6E	FLOAT32	[-... : ...]	mm
Measurement diameter	TCmfMesDia	–	0x6F	FLOAT32	[10 : ...]	mm
Chamfer width left flank	TCmfWidth_LF	bF	0x25	FLOAT32	[-... : ...]	mm
Chamfer width right flank	TCmfWidth_RF	bF	0x26	FLOAT32	[-... : ...]	mm
Z distance, finished workpiece	TCmfZDisToBot	h	0x27	FLOAT32	[0.1 : ...]	mm
Distance, reference tooth/ tool beginning (underside)	TDisRefToothBot	Y2	0x3C	FLOAT32	[-... : ...]	mm
Spacewidth for the ChamferCut tool	TGapSide	–	0x43	UINT8	0 = undefined 1 = both 2 = left 3 = right	–
Tip clearance angle	TTipRelAng	k	0x60	FLOAT32	[0 : 30]	deg

1) The length of the tool name is fixed at 32 bytes, must be completed with zeros and contains the name as well as the duplo number. The name identifies the tool relatively clearly, as long as it is not renamed.
2) Contains a maximum of 31 defective areas, consisting of a start and end value.

The ID 0xFF is reserved for future use.

Table 4.1: Tool data

The data types that can be used are defined as follows:

Data types

Data types	length (Byte)
CHAR	1
INT8	1
UINT8	1
UINT16	2
FLOAT32	4

Table 4.2: Data types

The possible input variants for the tip circle (0x1104) are defined as follows:

Tool types

Designation	Value
Diameter	0x01
Radius	0x02
Diagonal Dimension	0x03

Table 4.4: Input variants for the tip circle

The possible shift strategies for the tip circle (0x1304) are defined as follows:

Tool types

Designation	Value
Standard (per section until end of life)	0x00
Cyclic (alternating through all sections)	0x01

Table 4.5: Shift strategies

The possible tool types (0x1002) are defined as follows:

Tool types

Designation	Value
Undefined	0x0000
Hob	0x0065
Profile Milling Cutter	0x0066
Worm Gear Hob (Cylindrical)	0x0067
Worm Gear Hob (Tapered)	0x0068
Fly Cutter	0x0069
Duplex Cutter	0x006A
Hob for Rotors	0x006B
Profile Milling Cutter for Rotors	0x006C
Side Milling Cutter for Slots	0x006D
Gang Hob	0x006E
Internal Hob (Cylindrical)	0x006F
Skiving hob	0x0070
Grinding Worm	0x00C9
Profile Grinding Disc	0x00CA
Shaper Cutter	0x012D
Skiving Wheel	0x0191
Centering Disk	0x0385
ChamferCut Tool	0x03DF

Table 4.3: Tool types

Liebherr-Verzahntechnik GmbH
Gear Technology and Automation Systems
Kaufbeurer Straße 141 · 87437 Kempten
Phone +49 831 786-0 · Fax +49 831 786-1279
liebherr.com · info.lvt@liebherr.com

Liebherr-LinkedIn
https://go.liebherr.com/E8ByKq

Liebherr-Twitter
https://go.liebherr.com/T92xu7

Liebherr-Youtube
https://go.liebherr.com/QDydxV

BK LVT-Werkzeug-Identifikationssysteme-10.21_en