

**GENERAL
TECHNICAL
REQUIREMENTS**

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Change log

Current version	1.2
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New version	Date submitted	Date the change takes effect	Affected sections	Description of change
1.1	2022-10-28	2022-11-28	Marking requirements	1) Max dimensions for marking area removed 2) Marking requirement for cables added to table <i>Product markings</i>
1.1	2022-10-28	2022-11-28	Surface treatment requirements	1) Added requirement regarding blasting on machined surfaces
1.1	2022-10-28	2022-11-28	Electronics	1) General clarifications regarding electronics requirements
1.1	2022-10-28	2022-11-28	Welding	1) Clarification regarding WPS requirements
1.1	2022-10-28	2022-11-28	Weld execution	1) Added requirements regarding weld direction and weaving
1.1	2022-10-28	2022-11-28	Paint requirements	1) Clarification regarding defined color for engcon Yellow
1.1	2022-10-28	2022-11-28	Casting requirements	1) Opening up general requirements for casting defects
1.2	2023-03-17	2023-04-17	Bushings	1) Added requirements for bushings in new sub-chapter
1.2	2023-03-17	2023-04-17	Casting requirements	1) Clarification regarding Dimensional Casting Tolerance Grade
1.2	2023-03-17	2023-04-17	Paint requirements	1) Clarification regarding defined color for engcon Yellow

Introduction

This document, together with the *Supplier Handbook* and *How to deliver to engcon*, is the core of engcon's initiative to clarify and guide our suppliers on what we are expecting of the products and components we purchase and what we expect of the collaboration with our suppliers. These documents in the latest versions are available on www.engcon.com.

The *General technical requirements* functions as the baseline for technical requirements and dictates the minimum expectations of the products and components purchased by engcon. Some requirements are valid for all products and components while others are divided into sections based on production method, material and function.

The requirements included in this document applies, if not otherwise stated in item-specific drawings or otherwise agreed upon in writing.

General requirements

engcon expects the supplier to make sure all products and components delivered to engcon are produced according to the drawings or cutting file of the latest accepted revision. Furthermore, the supplier shall make sure that the material used meets the requirements specified in the product/part drawings or cutting file.

Where applicable, fixtures and jigs for welding and machining are to be used and if possible be based on the same date point.

Serial deliveries are expected to maintain the same quality and finish as approved outturn samples. Deviations from the outturn samples must be approved by engcon.

100% visual inspections must be performed of all products and components delivered to engcon.

Upon request from engcon, the supplier is expected to be able to show that the requirements included in this document are fulfilled.

Documentation

When engcon requires measurement protocols, they shall be clearly marked and enclosed with the shipments.

Marking requirements

engcon expects all purchased products and components to be clearly marked to enable traceability and handling on non-conformities and claims. Preferably, the marking of the product should not be done manually. The marking area is specified on the drawings. The marking requirements specified below are the minimum requirements from engcon, the suppliers are free to add other information if needed as long as it fits within the marking area.

Abbreviations

- Supplier (SS)
- engcon Item number (Art.)
- Date, Year Week (YYWW)
- engcon item number and drawing version (Art,- A)
- Drawing version (-A)
- Machining performed by(company) (B)
- Foundry (GX)

Product markings

Product type	Required marking
Upper Coupler/quick hitches/Cylinders	SS YYWW Art,-A
Worm Gear/Frame bearing/EC-Oil blocks	SS YYWW Art,-A
Center Ring	SS YYWW
Yoke Bracket/axels EC2XX/Gripping arms	SS YYWW
Axel with ears/End cover	SS
Valve Block/Connection block/swivel	SS YYWW ,-A
Welded rotator frames/Frame GRD, SG, PP, GS	SS YYWW Art ,-A
Engine cover	SS Art,-A
Upper coupler UNI welded	SS YYWW Art,-A
Upper coupler UNI machined	B YYWW Art,-A
Casted rotator frame casted	GX YYWW
Casted rotator frame machined	B YYWW ,-A
Locking hook PUP/QS	SS Art
Cables	SS Art,-A YYWW
Other products / components	SS

Table: Product markings

Production method specific requirements

Machining requirements

Unless otherwise specified, machining must be done in accordance with the latest accepted revision.

There must be established procedures for inspections and measurements.

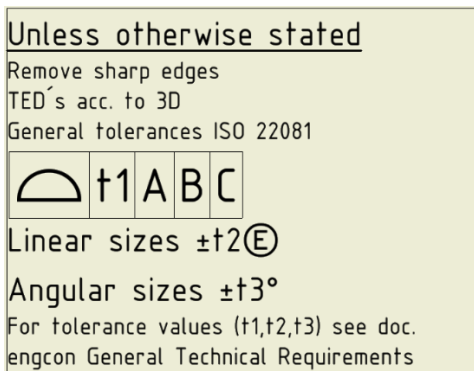
Holes and shaft hubs with set tolerances must have a surface smoothness of **Ra 3.2** or finer.

Delivered items shall be free from burrs and sharp edges.

Drawings & general tolerances

All machining drawings produced by engcon going forward are in accordance with **SS-EN ISO22081**. The now expired standard **ISO2768-2** is still valid for already produced drawings that refer to it. What standard the drawings are drawn up after is marked on the drawing.

As orientation, all drawings produced in accordance with **SS-EN ISO22081** will be marked with below picture.



Example drawing legend

Reading instructions for the drawing legend:

- TED (*Theoretical Exact Dimensions*) is found in the 3D models if not stated on the drawing
- All tolerances are stated together with the surface profile
- For general tolerances, the drawing legend refers to below tables in this document. All measurements are given in mm.

Surface profile tolerances:

ISO 22081 Surface Profile (t1)						
Nominal linear sizes	≤ to 6	6 < S ≤ 10	10 < S ≤ 25	25 < S ≤ 50	50 < S ≤ 100	100 < S ≤ 250
Tolerance values	0,2	0,3	0,4	0,5	0,6	0,75

Table: Surface tolerances

ISO 22081 Surface Profile (t1)				
Nominal linear sizes	250 < S ≤ 500	500 < S ≤ 1000	1000 < S ≤ 2000	2000 ≤
Tolerance values	1,5	2	3	4

Table: Surface tolerances cont.

Given tolerances in above tables represents the total tolerance span, e.g. 0.2 equals ±0.1

Linear tolerances:

ISO 22081 Linear sizes (t2)						
Nominal linear sizes	≤ to 6	6 < S ≤ 10	10 < S ≤ 25	25 < S ≤ 50	50 < S ≤ 100	100 < S ≤ 250
Tolerance values	±0,1	±0,2	±0,3	±0,4	±0,5	±0,75

Table: Linear tolerances

ISO 22081 Linear sizes (t2)				
Nominal linear sizes	250 < S ≤ 500	500 < S ≤ 1000	1000 < S ≤ 2000	2000 ≤
Tolerance values	±1	±1,5	±1,8	±2,0

Table: Linear tolerances cont.

Angular tolerances:

ISO 220810 Angular sizes (t3)					
Nominal angular dimensions	0,5 up to 10	10 up to 50	50 up to 120	120 up to 400	400 ≤
Tolerance values	± 1°	±0°30'	±0°20'	±0°10'	±0°5'

Table: Angular tolerances

Casting requirements

Unless otherwise specified, castings shall be in accordance with **ISO 8062-Dimensional Casting Tolerance Grade 10 (DCTG10)** or lower for machine formed molds and **DCTG 12** for hand formed molds .

Casting defects are classified and judged in accordance with **SS 114060**, general requirements for unmarked areas. Marked zones, if any, with corresponding local requirements are stated on the drawings.

Fettling/Cleaning shall be carried out in a way so that major visible areas that won't be machined afterwards are free from marks of cleaning tool.

Feeder placement shall be decided together with engcon Design.

Welding requirements

Personnel requirements

All welding personnel doing manual welding must be qualified according **ISO 9606-1** and welding operators, that operates welding robots, according to **ISO 14732**. At a minimum, welders must have passed fillet weld tests. Certificates for all welding personnel must be available upon request.

Joint preparation

Joint preparation may be specified in the drawing, but it is up to the supplier to form joints that ensure that the right quality is achieved.

Joint preparations are to be performed according to **ISO 9692-1**.

Welding datasheet WPS / WPQR

All welded products delivered to engcon shall be covered by WPS. WPS / WPQR documentation shall upon request promptly be made available to engcon.

Weld execution

Preferably 1.2mm (138) cored wire should be used.

Welds must be executed to **ISO 5817 D** standards apart from the items below:

- Dimension (a) too small (C)
- Dimension (a) too large (C)
- Incorrect fillet weld edge (C)

For manual welding max 5 mm dimension (a) permitted in one bead, dimension (a) from 6 mm must be welded with a minimum of 2 beads, from 8 mm with a minimum of 3 beads.

All intersections between two plates are to be welded if not otherwise stated. All welds with no specific welding instructions given on the drawings shall be welded according to the general reference (a=0,6 x t), which refers to the thinner plate in the joint.

Weld bead structure, weld direction and weld joint order must be selected so that the welds generate a minimum of inherent tension and deformations.

Only horizontal welding (pb weld) is allowed. Weaving is not permitted.

Support plates and reinforcements shall be used for all corners. Avoid starting and finishing welds close to corners.

Welding on mill scale is not permitted.

Welding spatter must be removed so that the surface finish enable further treatment such as painting.

Steel intended for welding must have the same temperature as the surrounding environment before welding is initiated, to avoid condensation issues.

If tack welds form part of the final weld, the same requirements apply as for the weld.

If tack welds do not form part of the final weld, they must be carried out in such a manner or ground sufficiently for them to be fully molten during welding.

Remaining tack welds must be at least 50 mm long or four times the coarsest material thickness if it is thinner than 50 mm.

Temporary welds (lifting lugs, start and stop plates etc.) must be removed in such a way that they do not affect strength and finish.

Cutting

If not specified on the 2D drawing, a thermal cut shall be in compliance with **ISO 9013** of range **5** for perpendicularity or angularity tolerance, range **4** for mean height of the profile and class **2** for limit deviations for nominal dimensions.

No sharp edges may remain on completion of welding.

Welding on high-strength steel

Aspects to pay special attention to when welding high-strength steel:

- Risk of cold cracks, hydrogen cracking
- It may be necessary to raise the working temperature.

Welding inspections

Suppliers are expected to have procedures for welding inspections and tests in place. Procedures should be available for presentation upon request from engcon.

100% of welds are expected to be visually inspected throughout the welding process.

Surface treatment requirements

Non-machined surfaces must be sand blasted to **Sa 2.5** as per **ISO 8501-1** before painting. Exception for components that cannot be blasted.

Only corrosion grade A is acceptable, corrosion pitting is not permitted.

Blasting sand must be removed before painting. The surface must be free from dust.

Sheet surface should meet the requirements **SS-EN 10163-2**

Painted surfaces must be free from contaminants such as mill scale, grease and rust.

Machined surfaces and threads must be free of paint unless otherwise specified on the drawing.

Machined surface refers only to machining carried out on completed products (not partially machined components).

Painting thickness: **minimum 80, max 120 µm**

All masking must be removed before delivery to engcon.

100% visual inspections must be performed.

Paint requirements

For the parts supplied to engcon already painted, it is crucial that the color is correct. Below is a list of colors used by engcon Group that are defined according to internationally accepted color standards. Color standard cards are used for all colors and all painted components shall be visually controlled against these cards prior to delivery. The cards are supplied by engcon with the order of a trial batch for new products or upon request by the supplier. engcon will visually inspect all painted parts using the mentioned color standard cards.

engcon Group defined colors:

- engcon black RAL 9005 Shine 25-35
- Engcon Yellow Use color standard card
- Mählers red NCS S1580-Y90R
- Drivex blue NCS 8010-R90B
- Plows delivered to Norway RAL 1007

Material specific requirements

Cleanliness requirements for hydraulic components

Hydraulics is central to the majority of engcon's products and cleanliness is paramount in ensuring a well-functioning and reliable hydraulic system. engcon therefore works hard to improve the cleanliness of our products. To achieve this, engcon is dependent on the cleanliness of the hydraulic components delivered by our suppliers. To reach the cleanliness target set for the hydraulic system, the cleanliness level of the purchased hydraulic component must be **ISO 16232 (V/A) (B16/C12/D10/E8/F4/G3/H1/I-N00)** or better at the time of delivery to engcon. This requirement applies for all hydraulic components purchased by engcon.

Upon suspicion of non-compliant components or at the start of delivery of new products or from a new supplier, engcon will send samples for analysis to an external testing institute. In case of non-compliance, engcon reserves the right to invoice the analysis costs to the supplier. If the sample is in accordance with **ISO 16232 (V/A) (B16/C12/D10/E8/F4/G3/H1/I-N00)**, engcon will cover the costs for the analysis.

Used plugs shall not be deformed when removed.

Steel plate surface requirements

General requirements:

- All steel plates must live up to the requirements in standard **SS-EN ISO 8501** and **SS-EN 10163-2**
- Only corrosion grade A is acceptable, corrosion pitting is not permitted
- Blasting shall be done to a standard of **Sa2,5** or higher
- No blasting on machined surfaces. If blasting is necessary after machining, all machined surfaces must be thoroughly masked and protected

engcon standard requirements for steel plate cutting is a complement to **SS-EN ISO 9013** and applies for side plates on *Top Parts* and *Machine Hitches*. Requirements are found below:

- 1) All cut surfaces must have an average roughness of $Ra < 30$
- 2) When measuring Ra , the reference length L shall be 15.0 mm
- 3) Measuring shall be done in line with the direction of the cut
- 4) If the required average roughness ($Ra < 30$) cannot be achieved, the cut surface must be grinded. Cuts deeper than **0,5mm** must be welded before grinding.
- 5) Starting and stopping point of the cut should be within an area that will be machined or welded
- 6) If the starting and stopping point of the cut cannot be within the specified area, the cut surface must be grinded

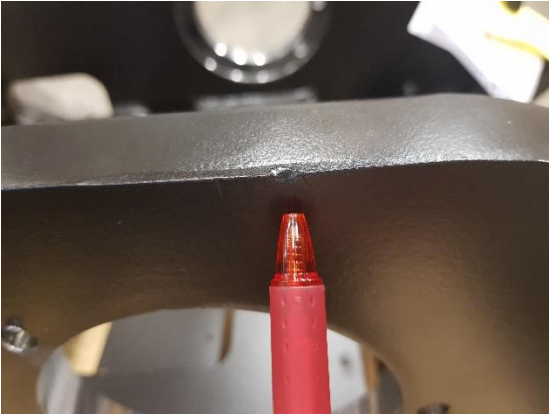
In general no visual damages or defects are allowed. Minor damages may be permitted in consultation with engcon Quality, send inquiries to quality@engcon.se. Damages or defects that could lead to cracking or material breakage is never permitted. Below pictures can be used as a guide in determining whether a damage or defect is permitted.

Not permitted damages / defects:



Example not permitted damages

Damages / defects that might be permitted after consultation with engcon Quality:



Example potentially permitted damages

Electronics

All electronics delivered to engcon shall be approved according to the local standards (e.g. CE, UL, FCC) for the respective markets. Upon request, engcon will provide information regarding what markets the products will be present on.

The supplier shall provide 3D and STEP-files for all electric components, if not developed by engcon, supplied to engcon.

All cables shall be electronically tested before delivery to engcon.

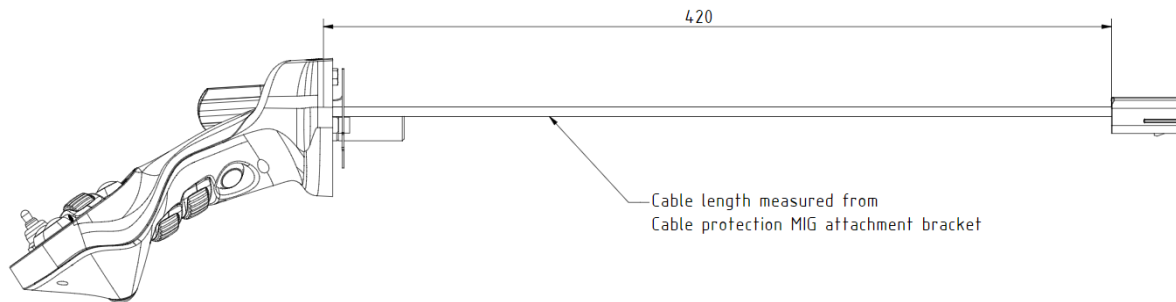
engcon expects the supplier to provide engcon with data sheets specifying below details for all electric components, if not developed by engcon, before first delivery.

- 1) Geometrical dimensions
- 2) Chemical resistance
- 3) Random vibration
- 4) Operating shock
- 5) Operating temperature
- 6) Storage temperature
- 7) Operating Humidity
- 8) Electromagnetic compatibility
- 9) Operating Voltage
- 10) Expected life
- 11) IP classification
- 12) What standards it has been tested by

In general it is, if not otherwise stated on the drawings, up to the supplier to ensure that type and dimensions of sleeves, PVC-tubing, and protective- and shrink tubing match the requirements of the intended application.

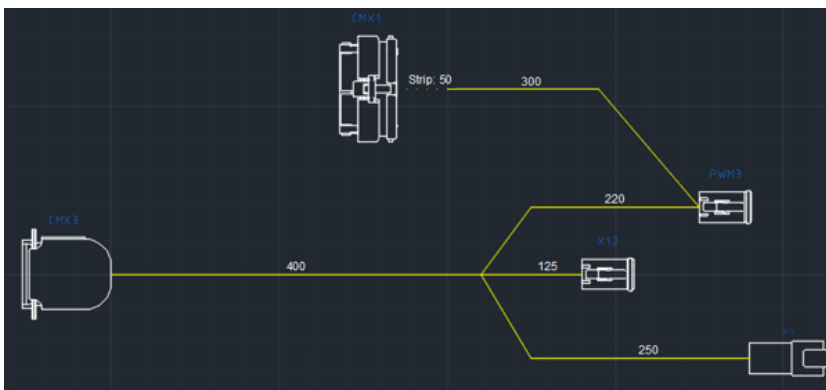
Drawings standard

All measurements are found on the overview page and are in millimeters (mm). If not otherwise specified, cable lengths are specified from back of connector to back of connector. For internal wiring or molded connectors, cable lengths are, as shown below, specified from the exit point of the product or connector.



Example length specification for internal wiring or molded connector

Cable lengths are specified using chain dimensioning for the segment in question up to the next branching or stripping, as shown in below picture. Other measurements are specified using dimension arrows.



Example chain dimensioning

Tolerancing

General tolerances (including tubing etc.), unless otherwise stated on the drawing

- Cable / other lengths <300mm: + 10mm / - 0mm
- Cable / other lengths 300mm – 1 500mm: + 20mm / - 0mm
- Cable / other lengths 1 500mm – 3 000mm: + 50mm / - 0mm
- Cable / other lengths 3 000mm – 10 000mm: + 100mm / - 0mm
- Cable / other lengths >10 000mm: + 2% / - 0%

Protective tubing

Placement of protective tubing is specified on the drawings. The measurements are specified for extended cables, the measurement will vary when the cable is rolled up.

Shrink tubing

In general two types of shrink tubing is used, with or without glue. If not stated on the drawings it is up to the supplier to ensure that the, for the purpose, appropriate tubing type is used.

Cable sleeving

For branched cables with cable sleeving, the sleeving of the branches are inserted into, at least 20mm, into the main sleeve and fixed according to the drawing. If the drawing does not cover fixation, it is up to the supplier to ensure that, for the application, sufficient fixation is used.

Markings

All cables shall be marked according to the table *Product markings*. The marking shall be UV-protected, water resistant and scratch resistant.

Separate conductors are to be marked according to the format [Tag:Pin – Function]. Prioritization for component tags shall be done as follows.

Control system DC2:

- CMX1-CMX3
- QCMX1-QCMX8 (not for cables going to/from CM)
- C2CX1-C2CX2 (not for cables going to/from CM or QCM)
- QLMX1-QLMX3 (not for cables going to/from CM, QCM or C2C)

Control system DC3:

- MGMX1-MGMX5
- BCMX1 (not for cables going to/from MGM)
- MCMX1 (not for cables going to/from MGM or BCM)
- CFMX1 (not for cables going to/from MGM, BCM or MCM)
- A2CX1 (not for cables going to/from MGM, BCM, MCM or CFM)

Stripping

Stripping lengths stated on the drawing refers to lengths outside the component in question, in accordance with abovementioned drawings standard. It is up to the supplier to add sufficient lengths to ensure correct assembly of the component. If stripping lengths are not stated on the drawing, it is up to the supplier to strip cables in a way that allows for a correct assembly of the components. The total length must not be affected.

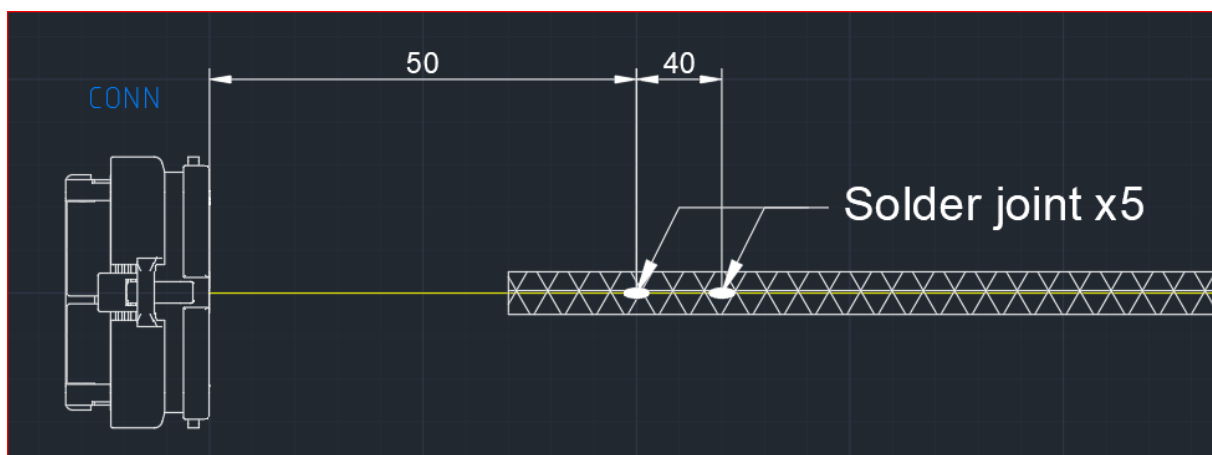
If a component has built in strain relief, the stripping must be done in a way that ensures that the relief is placed on top of the outer sheath of the cable.

Any unused conductors are cut at the edge of the outer sheath. Stripping with cut conductors are covered by 15mm glued black shrink tubing. The tubing shall overlap the outer sheath with 10mm and remaining conductors with 5mm.

Solder joints

Below requirements applies for all solder joints if not otherwise stated on the drawing.

- 1) If nothing else is stated, solder joints shall be done as a T-joint with a stripped gap, max 10mm long
- 2) The soldered joint shall be covered by a black and glued shrink tubing with an overlap of min 3mm and max 10mm on each side of the joint.
- 3) A T-joint can be replaced by an end-joint if stated cable areas and total length is maintained
- 4) If there are different cable areas on each side of the joint, end-joint shall be used
- 5) End-joints may **not** be substituted by a T-joint without a written approval from engcon
- 6) Joint placement is specified on the drawing. If there are several joints, the stated measurement refers to the outer joint, according to picture: *Solder joint dimensioning*. If a joint internal measurement is **not** stated, potential multiple joints are to be spread out towards the centre of the cable away from the connector which the stated measurement refers to.
- 7) Solder joints within a connector may be replaced by a double-crimp if the IP-classification can be maintained and only after a written confirmation from engcon



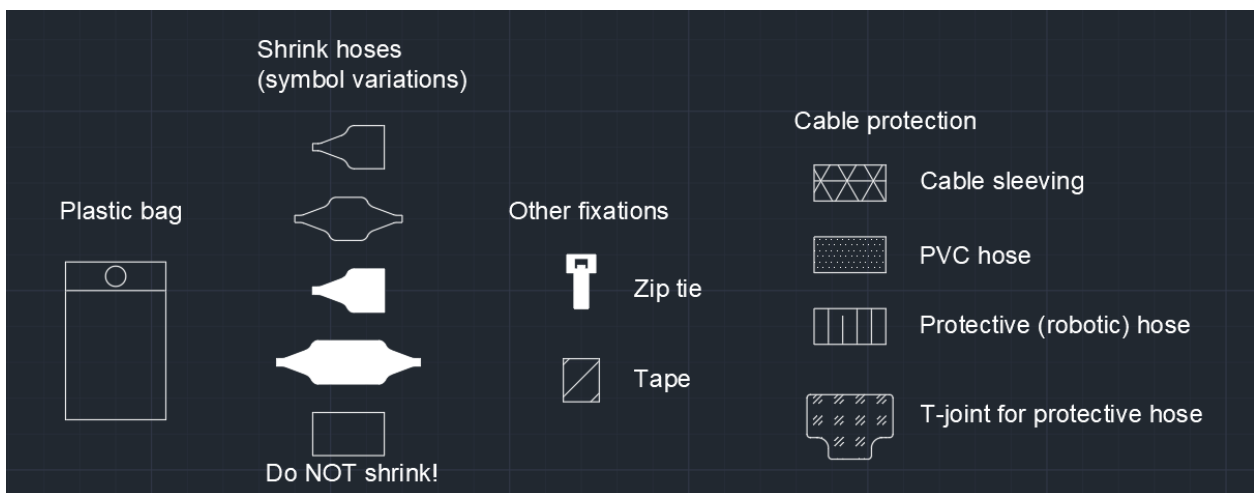
Picture: Solder joint dimensioning

Colors, symbols and abbreviations

Color abbreviations used on drawings are according to standard **IEC 60757** with the following additions:

- AG = Silver
- AU = Gold
- CU = Copper
- TP = Transparent
- DK = Dark
- LT = Light

Symbols used on drawings are according to picture: *Symbols on drawings*



Picture: *Symbols on drawings*

Bushings

In general, the sourcing decision for bushings is left to the supplier. However, engcon should be consulted before any changes in sub-supplier, material or manufacturing process. Bushings supplied to engcon can be divided into two major groups, *Lubricated bushings* and *Lubricant free bushings* (bushings with solid lubricant) and must be in accordance with below requirements.

Lubricated bushings

In general, *Lubricated bushings* shall be in accordance with **ISO 3547** with below added and clarified requirements. Type of bushing is stated on the drawings according to below naming convention. This applies for all drawings done after 2023-01-01. Older drawings will be updated over time when they are opened for revision.

Example: *Bushing EB3 - C85 90 x 35*

EB3: engcon identifier

C85: Type C bushing* - Inner diameter 85mm

90: Outer diameter

35: Width

* *Can be Type C bushing or type F bushing as specified in ISO 3547-1:2018*

Material shall be Y1/Y2 according to **ISO 3547-4: 2017**: CuSn8P / CW453K with below composition:

- Cu = 91,3%
- Sn = 8,5%
- P = 0,2%

Dimensions and tolerancing are according to **ISO 3547-1:2018** which applies also to chamfers and radius. Tolerance for shaft diameter is **e7/f7** and tolerance for housing is **H7**. Bearings pressed into housing with tolerance **H7** gets **H9** tolerance.

The bushings shall be specified for a temperature range of **-100 / +200°C**

Lubrication holes / indentations shall, if not otherwise stated, cover all bearing area.

Surface shall be free of burrs.

Bushing specific requirements:

Bushing	Hardness [HB]	Load [N/mm ²]		Yield strength (Rp0,2) [N/mm ²]	Tensile strength (Rm) [N/mm ²]	Friction μ	Lubrication type
		Static	Dynamic				
EB1	120-150	280	80-120	270-300	450-460	0,05-0,25	Holes
EB2	120-150	280	80-120	270-300	450-460	0,05-0,25	Indentations (diamond shaped)
EB3	110-150	250	80-120	250	450	0,05-0,25	Holes
EB4	110-150	250	80-120	250	450	0,05-0,25	Indentations (diamond shaped)

Table: Bushing specific requirements Lubricated bushings

Lubricant free bushings

Type of bushing is stated on the drawings according to below naming convention. This applies for all drawings done after 2023-01-01. Older drawings will be updated over time when they are opened for revision.

Example: Bushing EB5-F 25/31/38/1,5x20

F: Type F bushing*

25: Inner diameter 25mm

31: Outer diameter

38: Outer diameter of flange

1,5: Flange thickness

20: Total length of bushing

* Can be Type C (cylindrical) bushing or type F (with flange) bushing

Material shall have below composition:

- Cu = 62-68%
- Zn = Rest
- Al = 5-7,5%
- Fe = 2-4%
- Mn = 2,5-5%

Dimensions and tolerancing as well as chamfers and radius shall be according to drawing.

Recommended tolerance for shaft diameter is **d8**, **e7** or **f7**. Housing shall have **H8** tolerance. Tolerance for cylindrical bearing is according to drawing or standard: inside **F7** and outside **m6**. For flanged bearing the tolerance is according to drawing or standard: inside **E7** and outside **r6**.

The solid lubricant shall be of type **SL1: Graphite + additives: For normal conditions** and be specified for temperatures of up to **+400°C**. If not specified otherwise; it must be a pattern of solid lubricant of graphite. The pattern shall cover all bearing area. The solid lubricant shall cover **25-30%** of the sliding surface.

Bushing specific requirements:

Bushing	Hardness [HB]	Load [N/mm ²]		Yield point	Yield strength (Rp0,2) [N/mm ²]	Tensile strength (Rm) [N/mm ²]	Friction μ
		Static	Dynamic				
EB5	>210	150	90	450	>350	>750	0,03-0,20

Table: Bushing specific requirements Lubricant free bushings

Oils & Chemicals

All suppliers of chemicals to engcon shall follow REACH regulation (EC 1907/2006). Suppliers are encouraged to register chemicals supplied to engcon in the database for chemicals: www.ecoonline.se.

Plastics requirements

Flammability and UV-resistance is of main concern when it comes to plastic components.

Regarding flammability, all plastic components supplied to engcon shall live up to **UL94-V0** as well as **ISO 9773** for plastics in general and **ISO 9772** for cellular plastics.

For all externally mounted plastic components supplied to engcon, UV-stabilized material shall be used. Whether the component is externally mounted will be specified on the drawings.

