

Welding Requirements 1.0

- Bactoforce

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1. Introduction

The background for this document is to have a clear overview of what requirements the 'Vendor' (see definition below) needs to fulfil as supplier, when it comes to designing, producing and installation of equipment.

This document covers aspects of the welding of stainless steel of all dimensions.

Welding has a big impact on several factors:

- Strength
- Corrosion stability
- Cleanability and avoidance of hygienic problems

This standard is valid for welding in all stainless steels used and in contact with products and service media.

Equipment covered by PED-regulation (pressurised equipment) might need to meet additional requirements regarding welding. However, from a corrosion and hygienic point of view this standard must be followed.

2. Legislative Requirements

Equipment must fulfil all relevant legal requirements in the country of installation (national and local) and the European Council regulation, also when the installation is made outside EU. Always refer to the latest versions.

- EN 1935 Materials and articles intended to encounter food.
- Directive 2006/42/EC Machinery Directive.
- EN 1672-2 Food processing machinery - Basic concepts - Part 2: Hygiene requirements.

3. References

This document is based on best practice in the food industry.

DS/EN ISO 5817, Welding – Fusion welded joints in steel, nickel, titanium, and other alloys (Beam welding excluded) – Quality levels for imperfections.

Force Technology's Report 1337-3 (replacing no. 94.30). Reference color charts – for purity of purging gas in pipes of stainless steel. Always refer to the latest version.

- ISO 17637, Non-destructive testing of welds. Visual testing of fusion-welded joints
- EN 13018, Non-destructive testing - Visual inspection - General principles
- EHEDG Doc 9, Welding stainless steel to meet hygienic requirements.
- EHEDG Doc 35, Welding of stainless-steel tubing in the food processing industry.
- EN287-1 Qualification test of welders – Fusion welding.



4. Definition - Surface Area

Product contact surface is defined according to EHEDG.

4.1 Product Contact Surface

All equipment surfaces that intentionally or unintentionally (e.g., due to splashing) meeting the product, or from which product or condensate may drop or be drawn back into the main product or product container, including surfaces (e.g., unsterilized packaging) that may indirectly cross-contaminate product contact surface or containers. A risk analysis can help to define areas of cross contamination.

4.2 Non-product Contact Surface

All other exposed surfaces. Must be designed in a way so that it can be kept clean, with water and chemicals, normally used in food industry.

5. Welder Qualifications

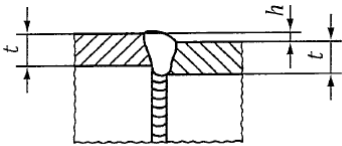
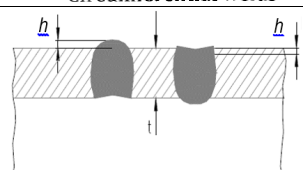
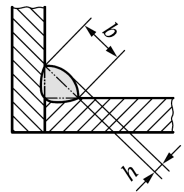
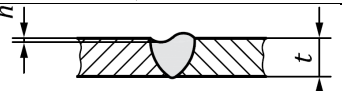
All welders must as minimum hold a valid certificate according to ISO 287-1.

When a welder joins the project, the record of people on site is updated and a validation of skills is performed. See 12 in this report - 'Vendors Quality Programme.'

6. Weld Quality

6.1 Welding Standard

All welding works must comply with current standards and requirements, EN ISO 5817 level B, and all welding works must reflect good workmanship. Supplemental requirements to EN ISO 5817. The points listed below will overrule the limits in EN ISO 5817 level B.

NO.	Imperfection designation	Remarks	t mm	Limits for imperfections for quality levels.
3.1	Transversely circular welds at cylindrical hollow sections	 <p>Circumferential welds</p>	>0,5	$h < 0,2 * t$ and max 0,25 mm
1.9 1.11 1.17	Concavity/convexity Excess penetration of welded seams (excess metal)		$0,5 < t < 2$	$h < 0,2 * t$ and max 0,25 mm
1.10	Excessive convexity (fillet weld)		0,5-4mm	$h < 1\text{mm} + 0,15 * b$
1.14	Incompletely filled groove			Not permitted in product contact areas



6.2 Color of Weld Zone

Welds are evaluated up against the most recent version of Force Technology's Report no. 1337-3. The discoloration must be equivalent to level C or less. Pre-tacking Welding

Root purge gas must always be used for pre-tacking welding. If an automatic tacking program, with a time control 1/100 sec intervals is available in the welding equipment then purge gas may not be required.

NOTE ! Pre-tacked weld will be inspected to the same conditions as the final weld i.e. discoloration as per Level C or less.

6.3 Product Contact Surface, Weld

The weld must have an even surface with no irregularities or sharpness and have a surface roughness of Ra <4,0 µm.

6.4 Outside Finish

The outside weld must be treated with pickling paste and washed, polished or another method to remove all discoloration and ensure the corrosion resistance of the weld.

6.5 Post Weld Treatment, Grinding polishing.

Weld with a discoloration from level G (hard penetration or coking) cannot be treated to restore corrosion resistance. Affected material must be cut out and replaced with new material (Force report no 1337-3).

7. Welding Demands

7.1 Pipes

Service pipes and product pipes.

Preparation of Pipes

To perform a pipe welding according to the standard the following must be met:

- Dimensions of pipes. Secure correct dimensions of pipes/fittings, only pipes/fittings meeting same standard can be welded together, ISO with ISO and DIN with DIN.
- Pipe cutting. All pipe cutting must be made by a mechanical mill, machined, or sawn with a sharp blade. Ensuring an even and rectangular cut.
- Surface preparation. Immediately before the welding, all surfaces in the heat affected zone must be cleaned and any grease or dirt must be removed with an appropriate solvent such as acetone, methanol, or spirit. Heat affected zone means weld joint area + 30 mm on either side of the joint.
- Alignment. For wall thickness ≤2 mm must be an autogenous weld (fusion weld, no filler used), this requires alignment to be correct.
- Fixing tools used during installation must be stainless on contact surfaces.



Welding Methods

All stainless product pipes must be welded using GTAW (Gas Tungsten Arc Welding) also called TIG (Tungsten Inert Gas) welding.

The welding can be made manually or by means of an orbital welder. As long as the quality demands are met, both methods can be used.

Filler

When filling material is used, it must be the best suitable and of a higher alloy than the parent metal.

Welding Logbook (pipes only)

The welding logbook must as minimum hold:

- Location
- Welder name
- Welder pass no.
- Drawing number
- Specification, purge gas used etc.
- All welded joints must be marked with the welder's personal identification number and a serial number to allow identification of the person who has performed the weld and the number of the weld job in the row. The numbers must be readable and available until the works are completed and handed over.

Gas - Purge Gas

The type of purge gas must be noted in the welding log. The purity of each batch must be checked with a test weld and documented.

Welding Product Contact Surface - not pipes

In general, the guidance for pipes must be followed. Grinding of welding seam can be required to secure the cleanability. This must be evaluated in each project.

Welding, Non-product Contact Surface

The welding work must reflect on good workmanship. The corrosion resistance must be secured. The finish must be smooth as non-product surfaces need to be cleaned and maintained clean during operation. Deviation from EN ISO 5817 level B can be acceptable but need to be agreed.

8. Heating-cooling Jacket/dimple jacket

When jacket is in contact with heating/cooling media, is welded, protective gas should be used, to avoid oxidation of the weld. Acceptance level is C in Force color atlas.

Pickling can be used to ensure corrosion resistance.

Visible welds must be treated with pickling paste or grinded after welding. See 0 6.5 Post Weld Treatment, Grinding polishing.



9. Grinding Polishing

When grinding/polishing is performed, it must be done from coarse to fine, in several steps, to avoid the grinding tracks being closed. The material must not discolor during the process. The material must not lose more than 10% and maximum 0,5 mm of its thickness due to grinding and polishing.

10. Verification Methods

To verify that welding has been made according to specification, one or more of the following methods can be used.

- Dimensions - Use a caliper, R measure blade.
- Discoloration - To judge the color of the weld, the Force color atlas is used.
- Visual - Pipe welds are inspected directly, with mirror or with endoscope, and evaluated according to these specifications.
- Welding seams in tanks - Tested with penetrant
- Ultrasonic/X-ray/Penetrant - Various methods are available to evaluate the welding and will be used where appropriate.

11. Weld Inspection

Pipe Installation

The Buyer reserves the right to inspect the welded joints himself or by Third Parties during the installation by i.e., endoscopy.

If inspection of a group of welded joints (minimum 5% is recommended) results in the finding of more than 3% defects, an extended inspection will be carried out, comprising additional 10% of the total number of welded joints. If this in turn results in the finding of more than 3% defects, the entire installation must be inspected. The installation Vendor bears all expenses in connection with the extended inspection as well as all expenses connected with inspection of the entire installation.

In case of doubt an independent body for Visual inspection must be involved. The party unsuccessful in its claim will bear the fee.

The Vendor must remedy all defects found.

When failure on a weld is detected, it will be registered. In some cases, the weld can be re-welded to meet the standard, but it will still be counted as a failure, and can lead to further inspection.

All repaired defects must be re-tested.

Warranty, Pipe Installation

The quality of the welded joint must not impair the installation, meaning that the welded joint must be just as durable as the base material. The Vendor must issue a warranty for a period of 5 years from the date of handover. This means that if the welded joint, but not the parent metal corrodes, the weld has not been performed properly, and the Vendor can be held liable.



Tank build

Internal welding/surface must be penetrant tested as part of the Factory Acceptance Test in the workshop and as minimum before 1 year of operation, to secure no defect related to design, material, finish, or welding is present.

Warranty, Internal Tank Welding

To secure that the design and manufacturing is robust and resilient for use in operating conditions a 3–5-year warranty is recommended.

12. Vendors Quality Programme

The Vendor must have a quality program in place to secure and document that the welding is performed according to this standard.

- Welder qualification/welder quality verification
- Securing that the requirements in this standard are known and accepted within the Vendor's organization. Including sub-suppliers.
- Welding log (see 0 Welding Logbook (pipes only))
- A welding inspection program, done by the welder after performing a weld as well as an overall control of the welder's work.
- Full traceability between welder weld, and material.

The system must secure that it covers the full scope from planning to handover to buyer.

The system must be in place before manufacturing or installation starts.

The Buyer reserves the right to audit the system without warning.

13. Deviations from This Standard

All deviations from this standard must be listed and agreed by buyer.

