BIOZEEN®

*We are into the business of Saving Lives*

# Types of stainless steel and welding controls applied in the pharmaceutical industry for product-contact areas.

Sarin Simon

10.06.19

# Agenda

- Biozeen Introduction
- Stainless Steel
- Types of Stainless Steel used in biopharmaceutical industry
- Selection of the Stainless Steel
- Welding in bioprocess equipment
- Controlling welding
- Welding Documentation

# Noble Cause , Unique Model


**Total Solution Partner to the Biotech World**

# NOBLE CAUSE , UNIQUE MODEL

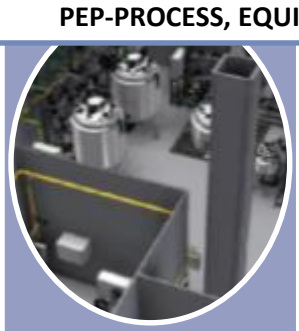
PEP-PROCESS, EQUIPMENT, PEOPLE

**Design Build Solutions**

Bioreactor systems
Fermentor systems
Process systems
CIP and SIP systems
Filtration systems
Bio-Kill systems
Sanitary Vessels
Crystallizers
Interconnection piping

**Automation Solutions**

- Plant Automation
- PLC Programming
- DCS Systems
- Automation Up gradation



**Technology Services**

- Process Design
- Process Optimization
- Contamination trouble shooting
- Process Validation
- Project Management

**Research & Development**

- Efficiency Improvement studies
- Glycosylation
- Perfusion with micro carriers
- Algae culture
- High cell density of VERO / CHO cell lines

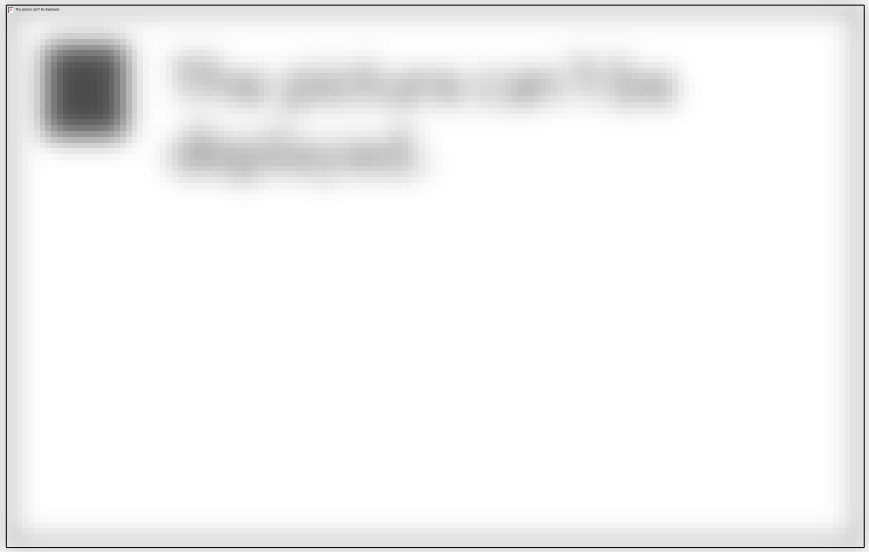
**Manpower Training**

- Fermentation Technology
- Mammalian Cell Culture Technology
- Downstream Processing
- Sterilization & Filtration Technology
- Bioprocess Engineering
- Regulatory Aspects & Documentation

**BiOZEEN Regulatory Services**

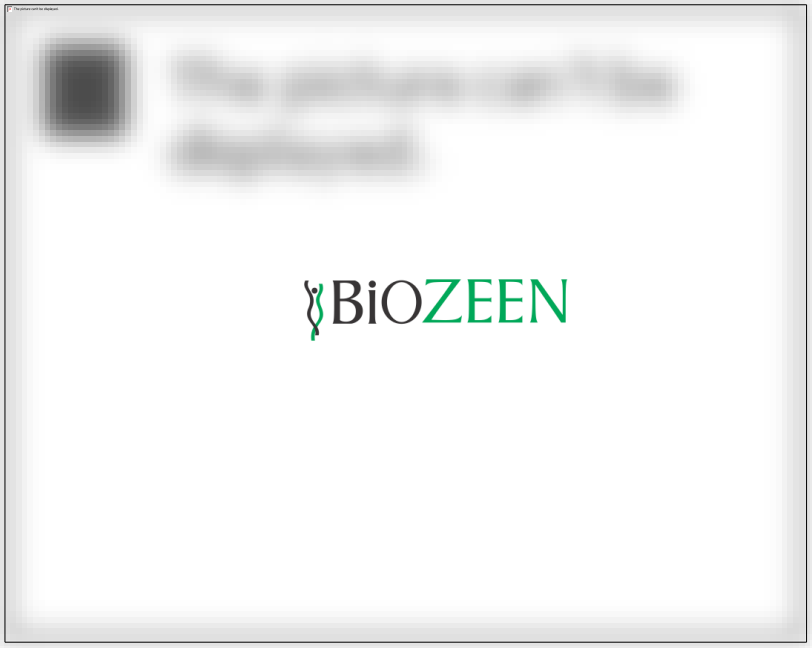
- Filter Train Optimization Study
- Compatibility Study
- Product based Integrity Study
- Bacterial Retention Study
- Protein & Preservative Binding Study

# BiOZEEN DESIGN & BUILD INFRASTRUCTURE



## Manufacturing Workshop

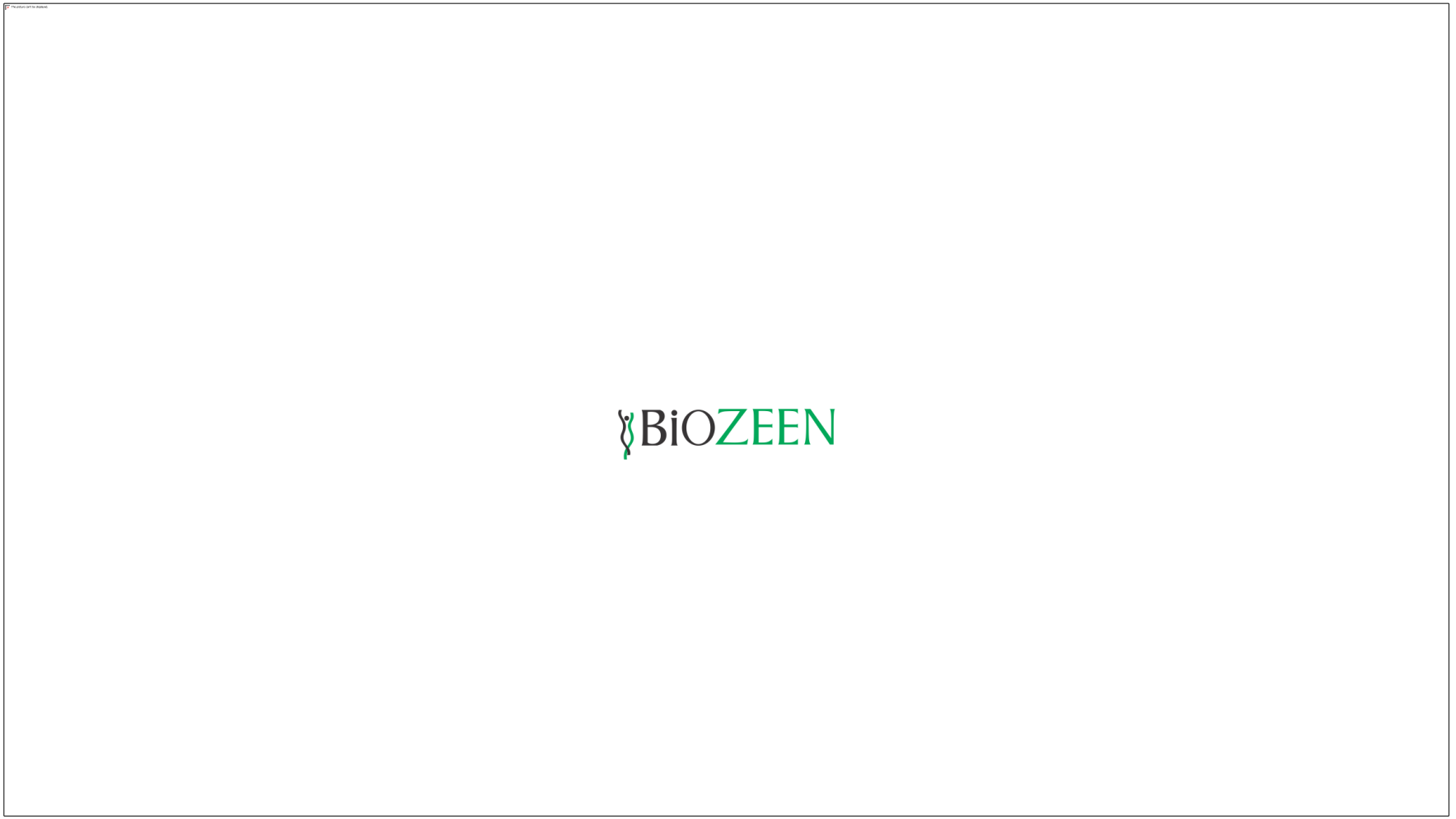
- Campus spread across 4 Hectares
- Floor area of 35,000 Sq. ft
- Executed Bioreactor/ Fermenter from 1L to 10000L
- In-house facility for electro polishing



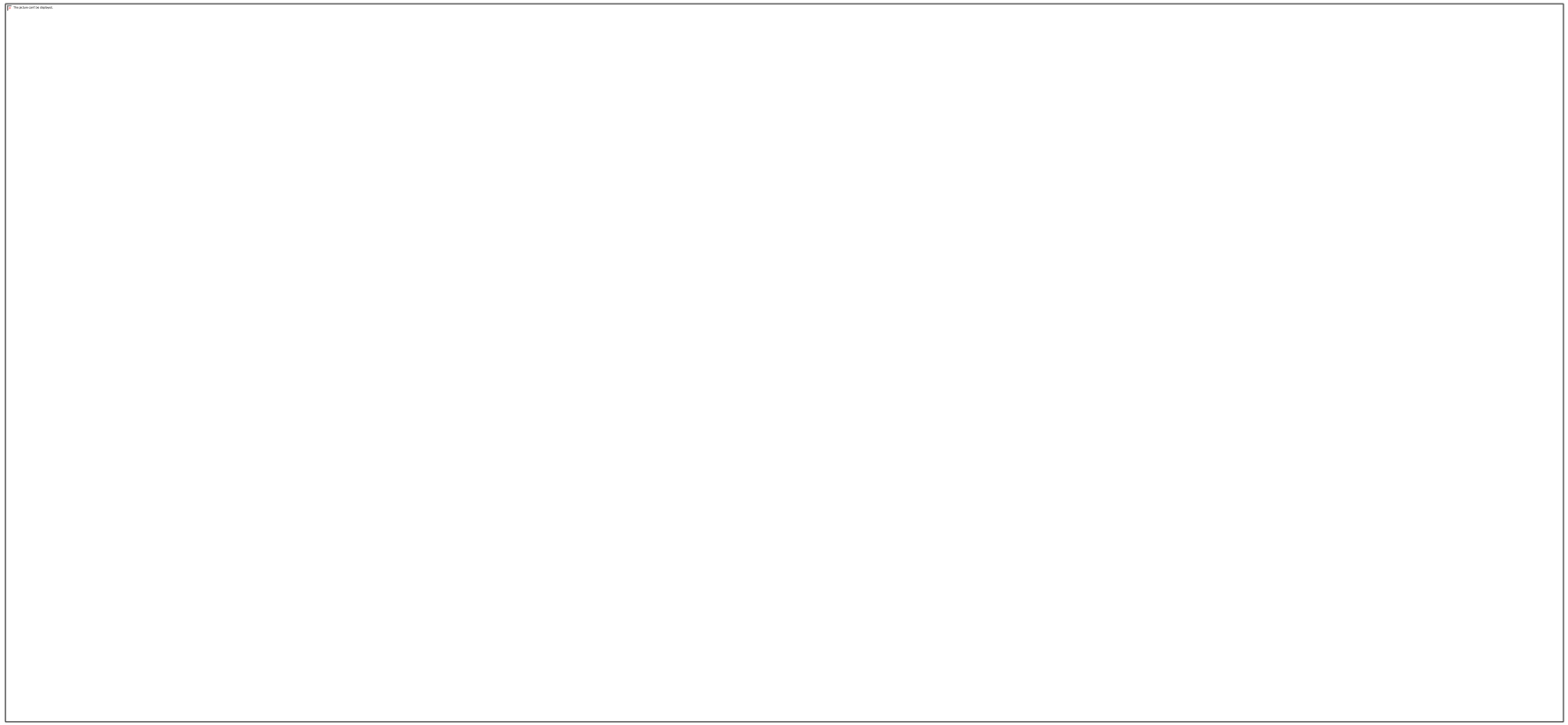

- State-of-the-art Quality Control Units
- Clean and Black utilities
- Boilers, Chillers, Compressors, WFI generators

## Integrated FAT centre

# BiOZEEN Facility Layout



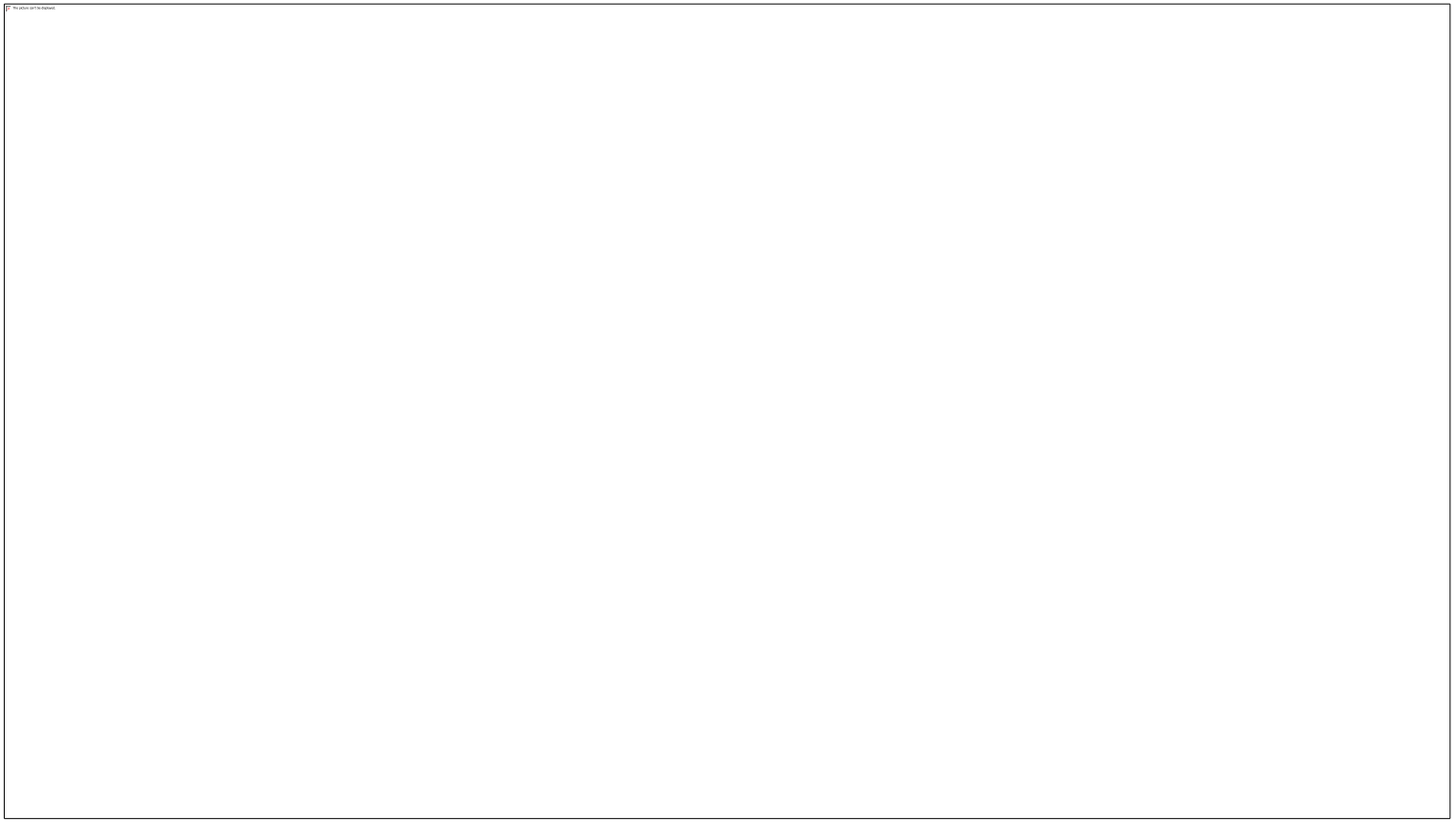
# BiOZEEN DESIGN & BUILD INFRASTRUCTURE



**Manufacturing Workshop**

- State-of-the-art New Manufacturing Centre located in Hardware Park, Bangalore, India
- Floor area of 50,000 Sq. ft
- Operational since June 2018

# BiOZEEN DESIGN & BUILD INFRASTRUCTURE



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## Manufacturing Workshop

- State-of-the-art New Manufacturing Centre located in Hardware Park, Bangalore, India
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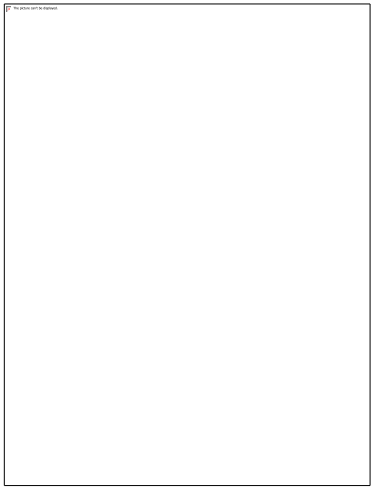
- Operational since June 2018

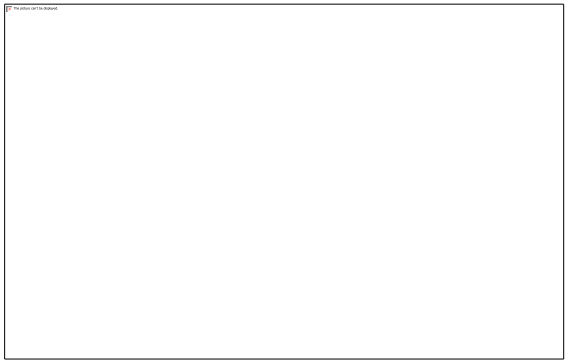
# Stainless Steel

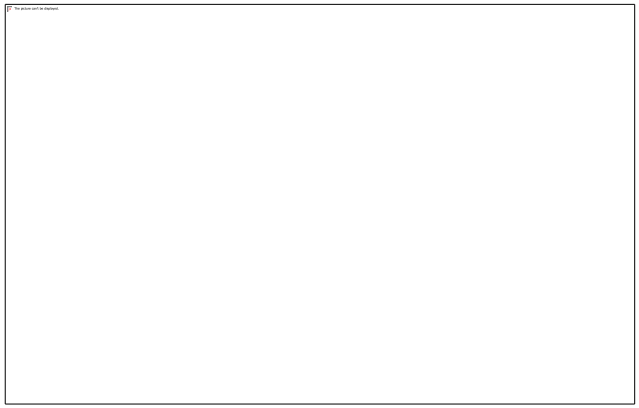
# Stainless Steel

The date was June 4, 1912

Harry Brearley was in charge of the Brown-Firth Research Laboratory in Sheffield, England.







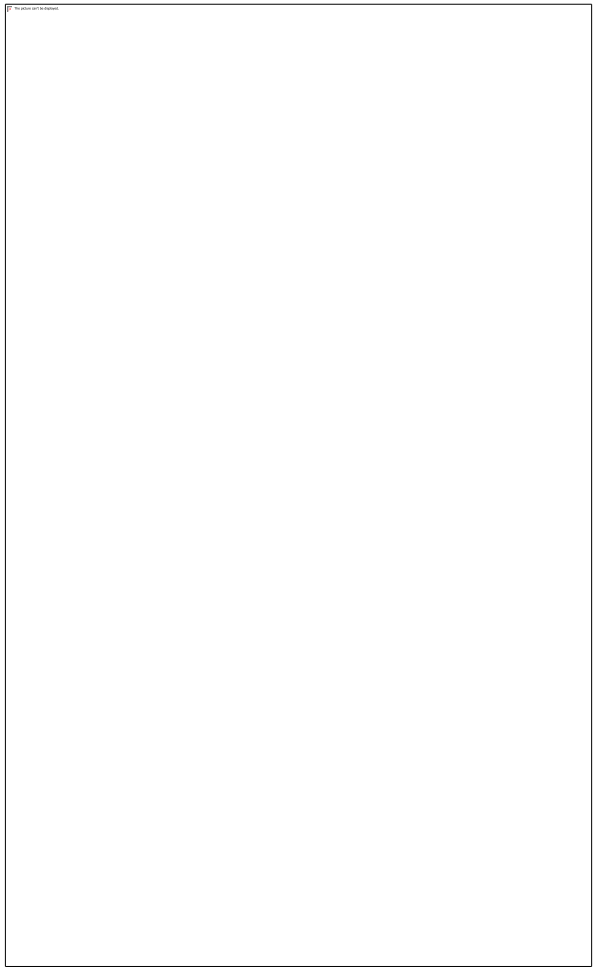
While the lab was investigating ways to eliminate rust in gun barrels, Mr. Brearley noticed that a discarded steel sample from an earlier test was not rusting while the other samples rusted.

Two months later, on August 20, 1912, stainless steel was cast for the first time

# Stainless Steel

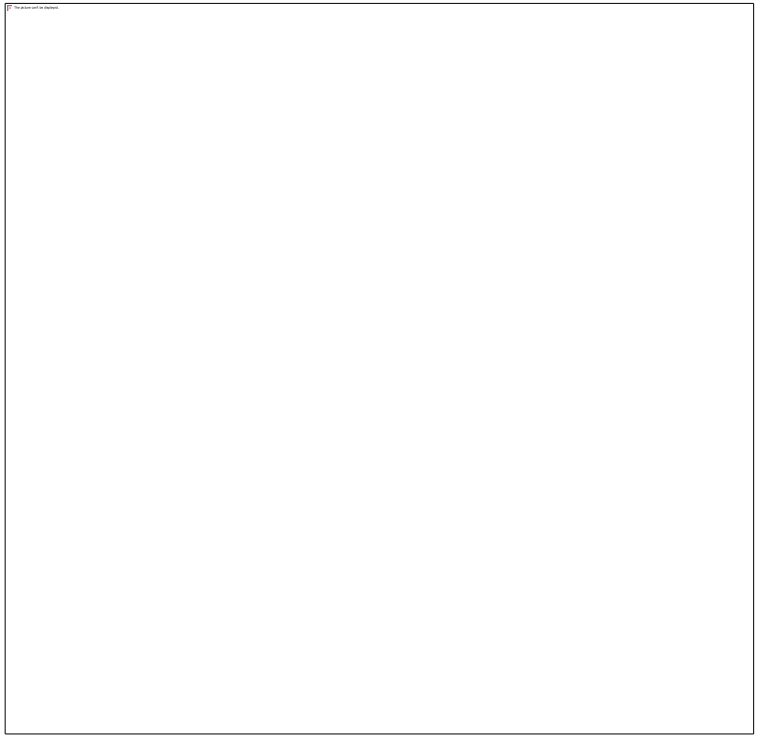
Even though many people were involved  in finding Stainless Steel, records consider Mr. Brearley as the inventor of Stainless Steel !

(No work is done without documentation)



# Types of Stainless Steel

Today, there  are 200 types of Stainless steels available.



As these 4 elements change,

- Type of stainless steel change
- Composition Changes
- Properties Changes

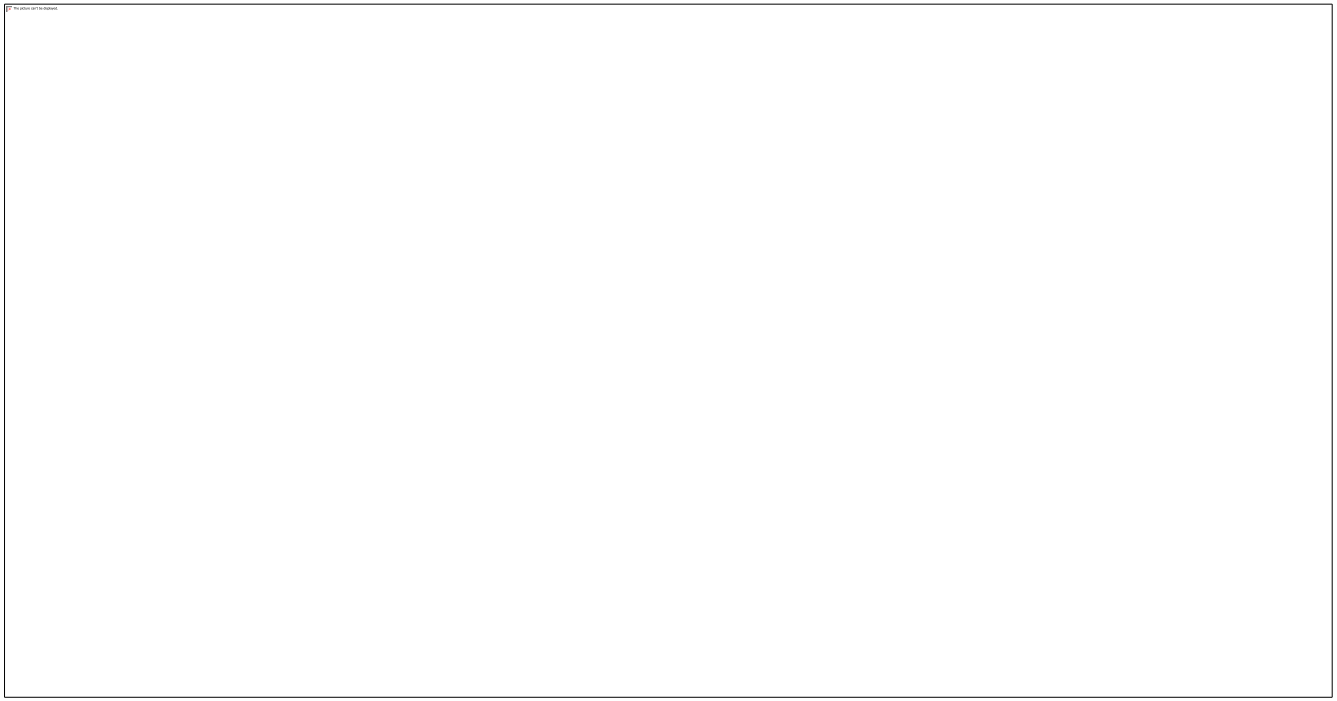
# Types of Stainless Steel

- **Austenitic:** High Chromium and Nickel content of the grades in this group provide superior corrosion resistance and very good mechanical properties ( eg: 304, 304L,316, 316L)
- **Super austenitic:** A subgroup of austenitic stainless steels. Having elevated levels of nickel, chromium, and molybdenum compared with standard austenitic stainless steels. May have other additions (e.g., nitrogen and/or copper) to increase strength and resistance to pitting corrosion and stress corrosion cracking in the presence of chlorides. (eg: 904L(N08904), 6MO/254 SMO (S 31254), AL-6XN (N08367)
- **Ferritic:** A higher corrosion resistance than martensitic grades, but are mostly inferior to the austenitic grades. These grades are straight Chromium steels with no Nickel ( eg: 409, 405,430, 444)

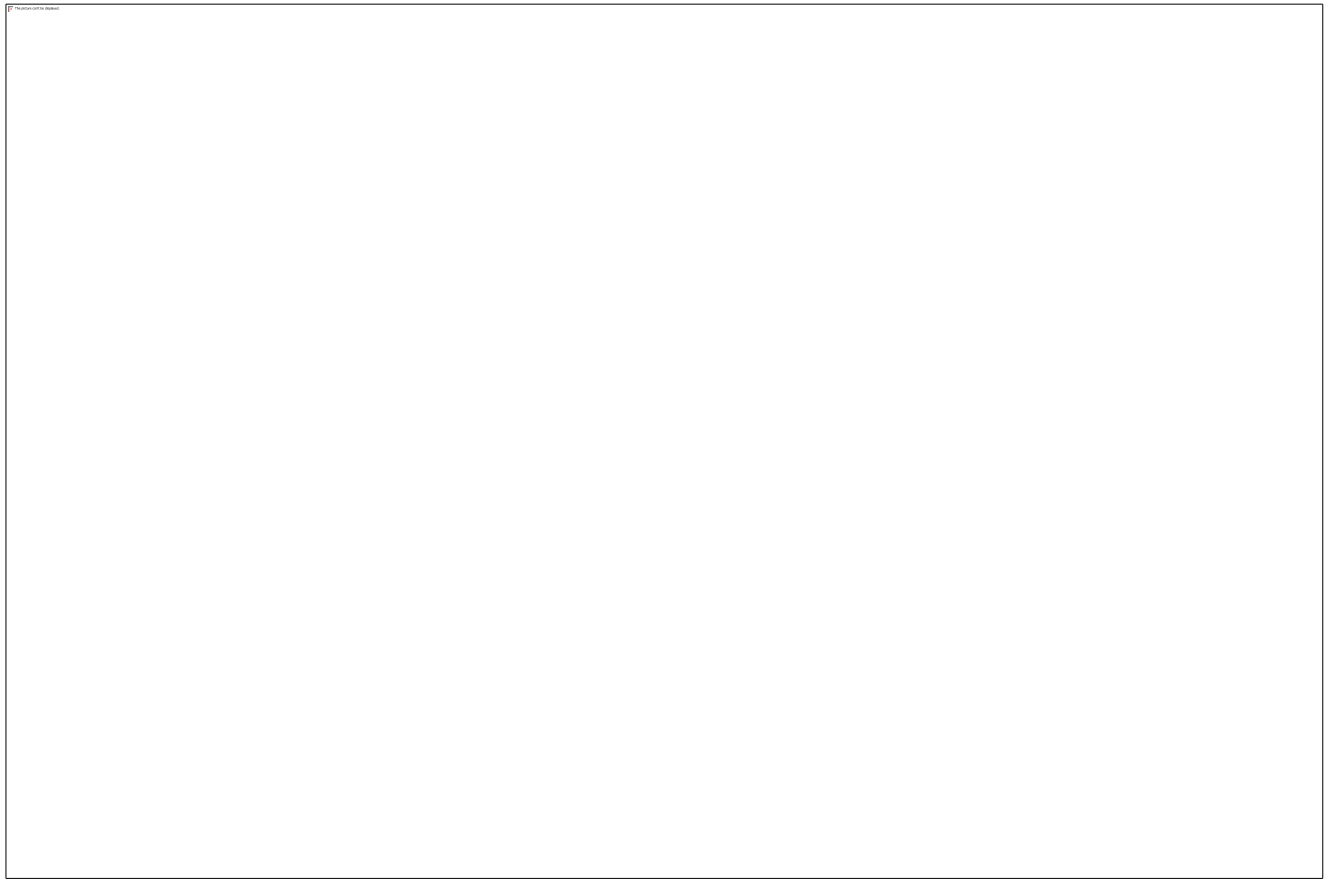
# Types of Stainless Steel

- **Martensitic**: A group of stainless alloys made to be corrosion resistant and hardenable (using heat treating). Chromium steels without nickel. Used where hardness, strength, and wear resistance are required like filter holder support and cross flow filter bars etc. ( eg: 410, 420,440A, 440C)
- **Duplex :** Duplex grades are a combination of austenitic and ferritic material. Twice as strong as the austenitic and ferritic grades. Better toughness and ductility than the ferritic grades, they do not reach the levels of the austenitic grades. Duplex grades have a corrosion resistance very close to the austenitic grades such as 304 and 316. Grade 2205 is the most widely used in the duplex class
- **Precipitation hardening** : Precipitation hardening stainless steel can be strengthened and hardened by heat treatment. This offers the designer a unique combination of fabric-ability, strength, ease of heat treatment, and corrosion resistance not found in any other class of material. These grades include 17Cr-4Ni (17-4PH) and 15Cr-5Ni (15-5PH)

# Types of Stainless Steel



# Types of Stainless Steel



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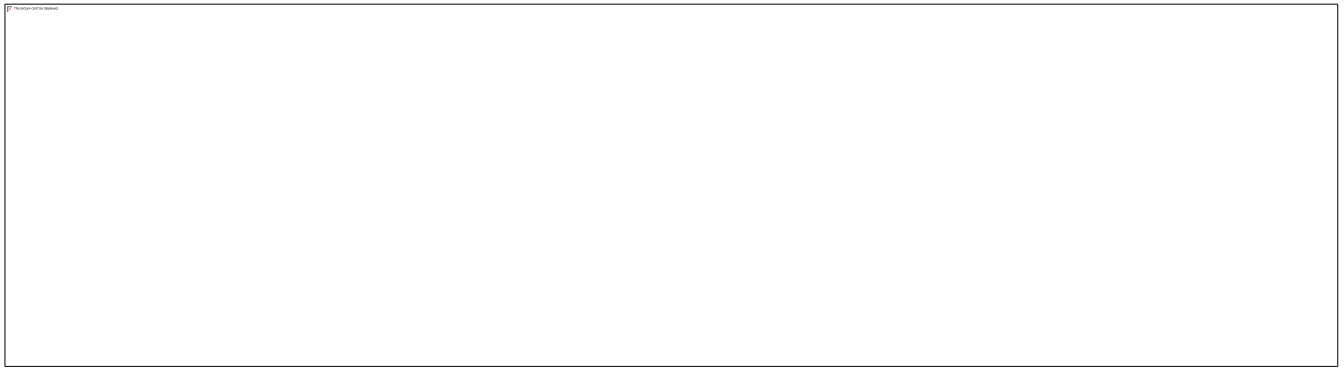
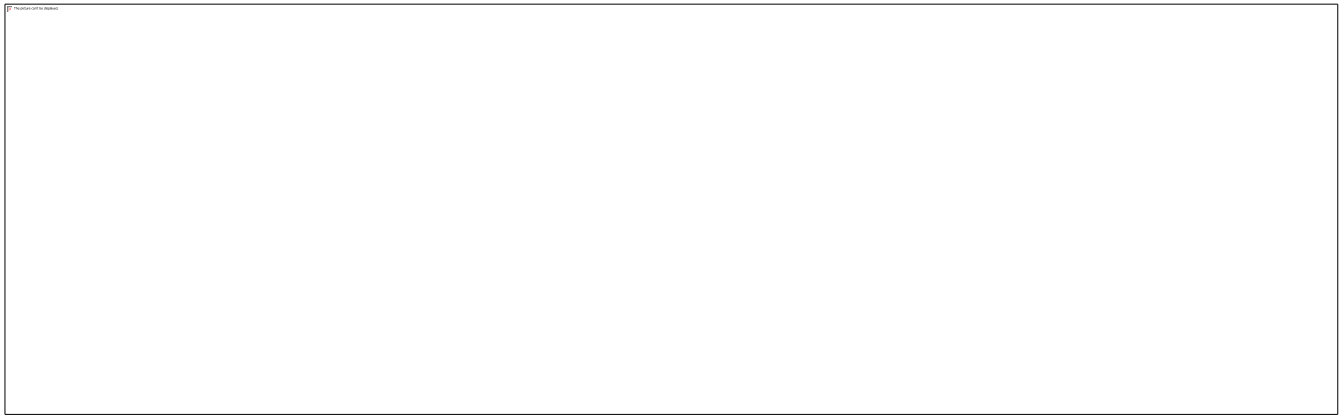


# Types of Stainless Steel

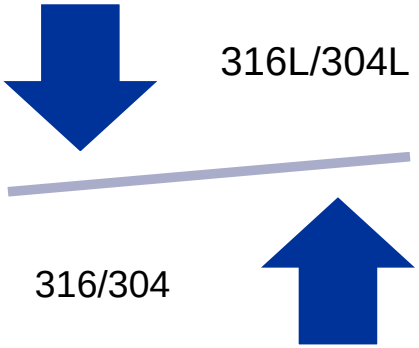


# Types of Stainless Steel

# Types of Stainless Steel

# Types of Stainless Steel – Product Contact

- **Type 316:**
- 18% chromium, 14% Nickel and added Molybdenum
- In combination increase its resistance to corrosion.
- In particular, molybdenum helps to control the pit type attack of corrosion.
- The “L” grades provide extra corrosion resistance **after welding**. (Carbon levels are kept to .03%)



# Types of Stainless Steel – Product Contact Surface

- **Type 316L (1.4435):**

  Slightly higher
- (17.0to19.0%) chromium,
- (12.5 to 13.5% Nickel) and
- (2.5 to 3.0%) Molybdenum.
- This grade stainless steel helps in control of delta control at the welding area.
- (outcome of the Basler Norm 2 that tried to reduce concerns of rouging)

# Select the Right Stainless Steel

How do we select the right one for our application?

- Corrosive environment : Atmospheric, water, concentration of particular chemicals, chloride content, presence of acid
- Temperature
- Strength Required
- Metal Joining Process Required
- Degree of Forming Required
- Product Form Required
- Surface Finish Required
- Cost

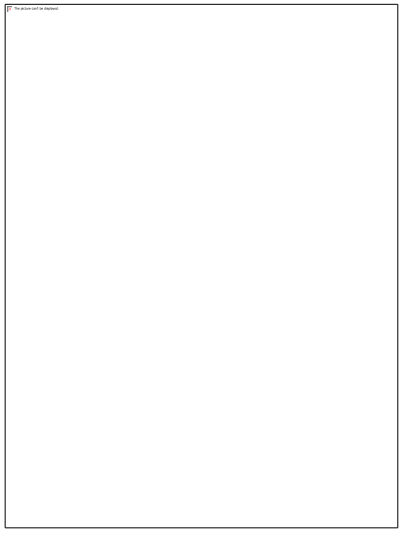
When in doubt, please share the process details & chemicals that come in contact to the manufacturer to check the compatibility.

# Stainless Steel Welding

# Stainless Steel Welding

For pressure vessels, tanks, piping and tubing systems where the process contact surface of the weld is to be used “As is”,

- welding processes shall be limited to the inert-gas arc processes (such as gas tungsten-arc welding and plasma arc welding)
- the high energy beam processes (such as electron beam or laser beam welding), as defined in AWS A3.0



# Gas Tungsten Arc Welding

Joining of metal by placing an arc in between the metals

Shielding with an inert gas or mixture.

With or without filler material

Manual or automatic (orbital welding)

# Weld Controlling

S-Sulphur control in Steel

O-Oxygen control in Welding Gas

F-Ferrite control in Steel

T-Tungsten control in process

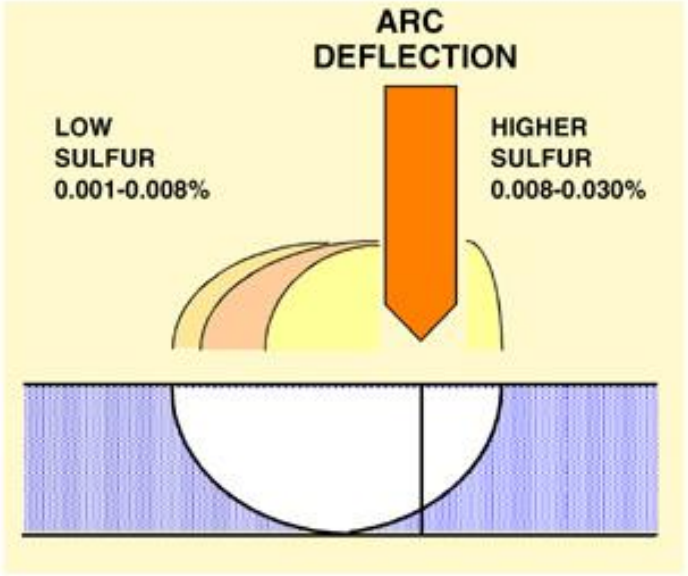
# Weld Controlling - Sulphur

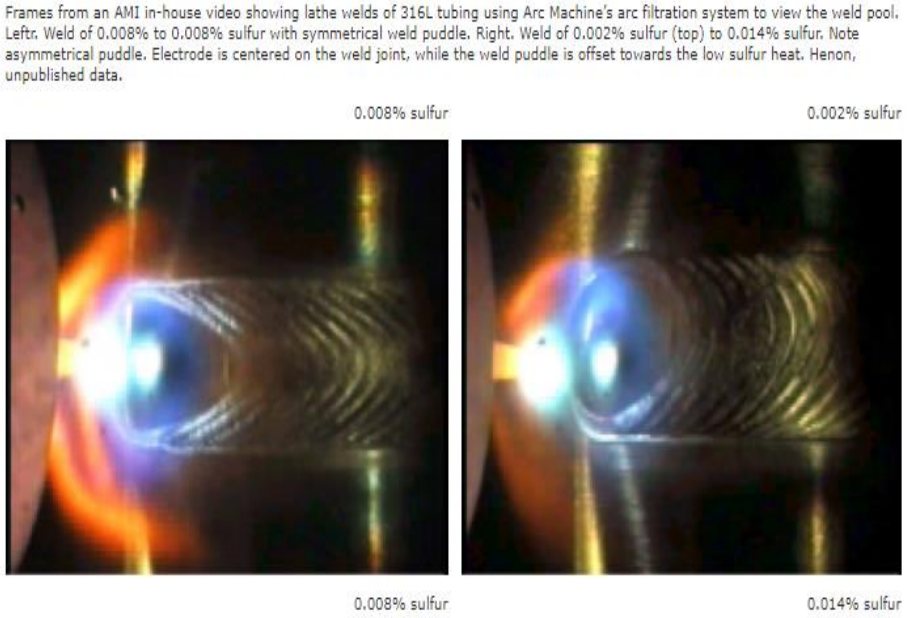
MM-5.2.1.1 Weld Ends.

Weld ends that are to be automatically welded shall have a Sulphur content between 0.005 wt. % and 0.017 wt. %

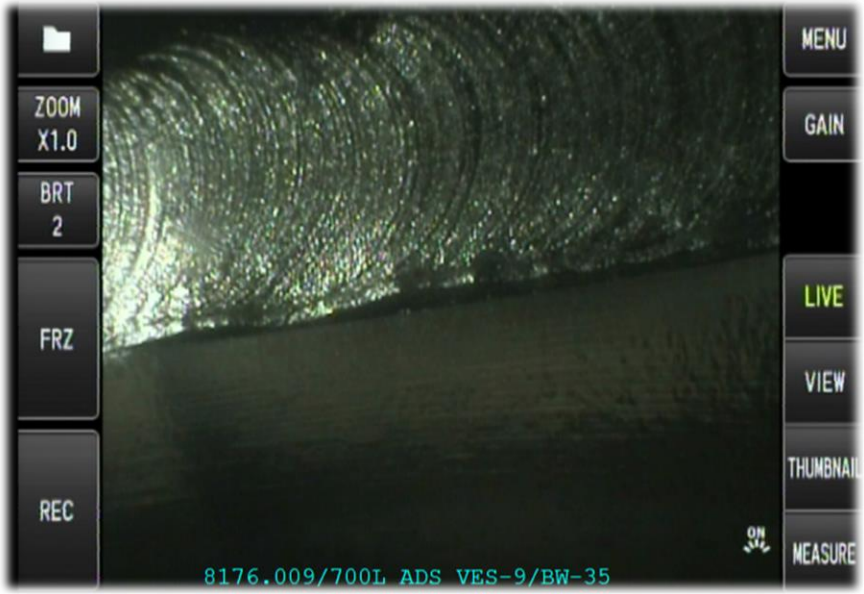
This requirement applies to the austenitic stainless steels

This requirement does not apply to materials used in the construction of process components, only to the weld ends of process components in their final form.



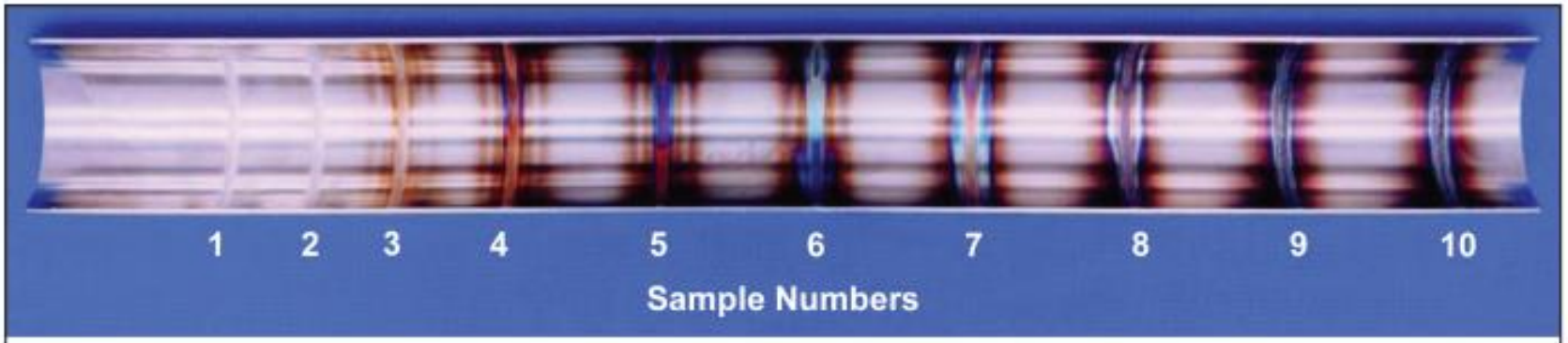



# Weld Controlling - Sulphur




# Weld Controlling - Oxygen

Oxygen contamination during welding leads to Discoloration and corrosion!




Notes:

1. The tube sample was prepared by making ten autogenous welds on the outside diameter of a 2 in. (50.8 mm) 316L stainless steel tube. Welds on 304L tubing showed no significant difference in heat tint from 316L. The welds were full penetration welds. The torch shielding gas was 95% argon, 5% hydrogen [99.998 with <2 parts per million (ppm) of oxygen, moisture, and hydrocarbons] to assure full penetration welds. The hydrogen addition to the torch shielding gas is considered to have no effect on the HAZ heat-tint oxide on the inside surface. To provide varying amounts of oxygen in the backing gas a compressed cylinder of medical grade air was added to 99.98% minimum pure argon (<2 ppm of oxygen, moisture, and hydrocarbons) and the oxygen was measured with a calibrated commercial oxygen indicator. The amount of oxygen in ppm in the backing gas was measured to be as follows:

| | | | | |
|---|---|---|---|---|
| No. 1–10 | No. 3–50 | No. 5–200 | No. 7–1000 | No. 9–12500 |
| No. 2–25 | No. 4–100 | No. 6–500 | No. 8–5000 | No. 10–25000 |

2. The illustration should be used as a reference to identify the degree of heat-tint oxide by number and not to specify oxygen limits in the backing gas. The acceptable degree of heat tint can vary with different service environments. It should be considered along with the economics involved obtaining very low levels of heat tint when specifying acceptable heat tint level welds.

   The amount and visual appearance of heat-tint oxide can be influenced by factors other than oxygen, such as:

   - High levels of moisture in the backing gas will increase the degree of heat-tint.
   - Contaminates such as hydrocarbons, moisture, and some types of particulate on the surface prior to welding can influence heat-tint oxide levels.
   - Hydrogen gas in the argon backing gas can significantly reduce the amount of heat-tint oxide.
   - The metal surface finish can have a varying affect on the visual appearance of heat tint.

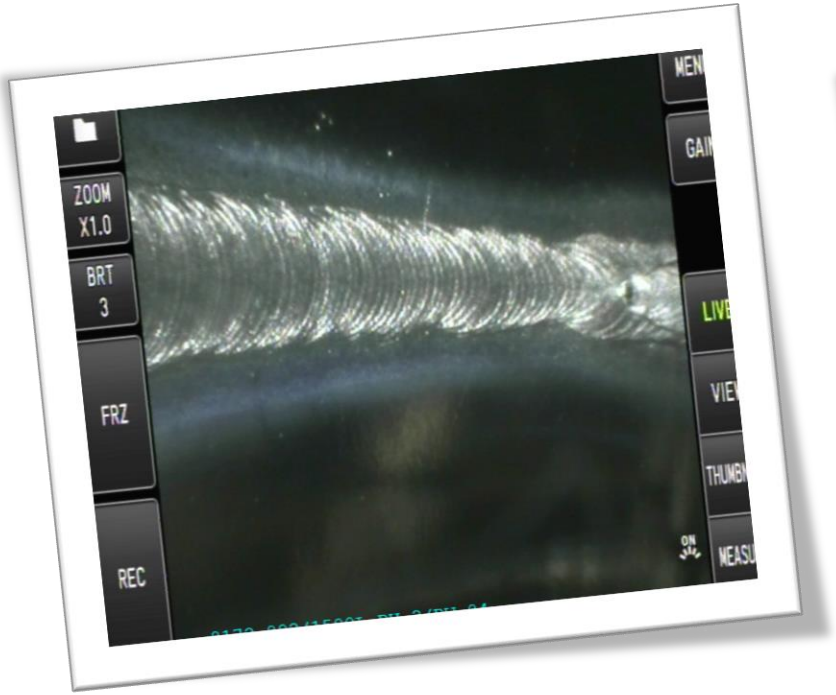
Figure 10. AWS D18.2 weld discoloration chart.

# Weld Controlling - Oxygen

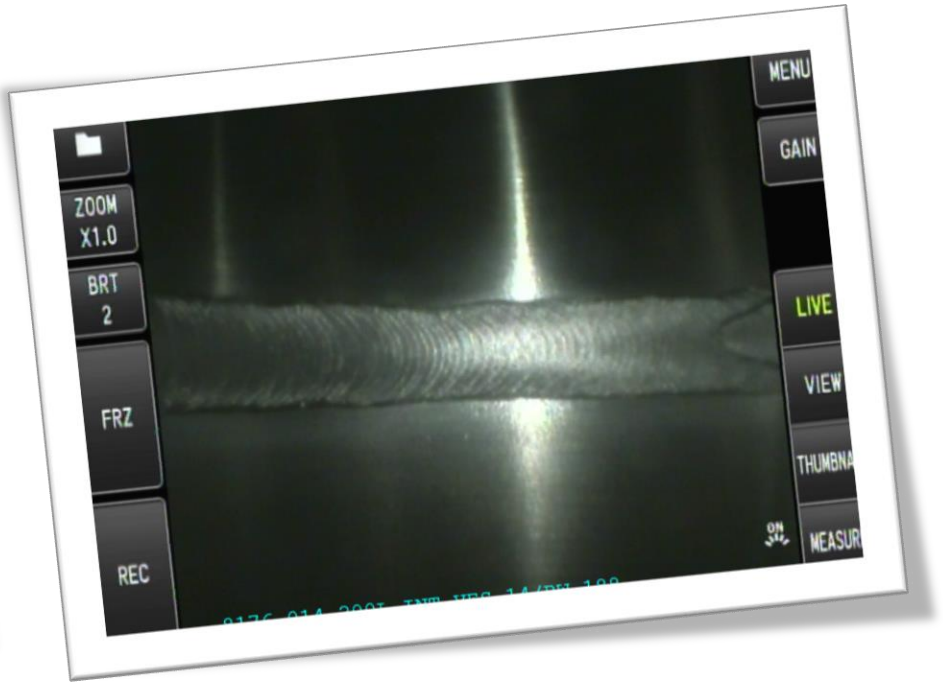
Oxygen contamination during welding leads to Discoloration and corrosion!


# Weld Controlling - Oxygen

Oxygen contamination during welding leads to Discoloration and corrosion!




Without Oxygen Monitoring




With Oxygen Monitoring

# Weld Controlling – Delta ferrite

Ferrite is a phase that may precipitate during solidification of austenitic stainless steel depending on the ratios of the alloying elements.

The presence of ferrite in austenitic stainless steel welds may reduce the corrosion resistance in some corrosive environments.

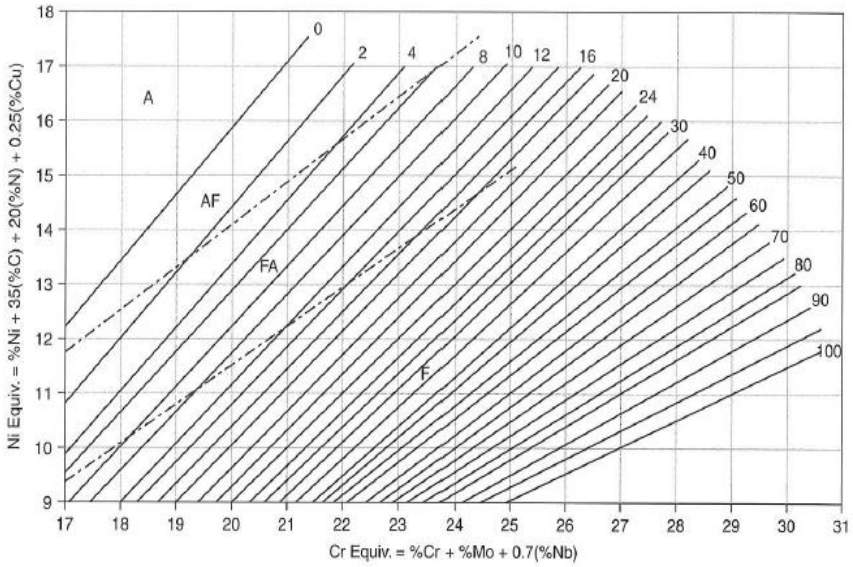
However, a minimum ferrite level may be required to maintain specific properties of particular product forms (e.g., castings) or is deemed necessary to prevent hot cracking of heavy wall weldments (e.g., vessels made from plate).

The ferrite level of as-solidified austenitic stainless steel welds can be determined from the WRC-1992 Constitution Diagram for Stainless Steel Weld Metals using

- Chromium equivalent Cr (eq) p %Cr + %Mo + 0.7%Nb and
- Nickel equivalent Ni (eq) p%Ni + 35%C + 20%N + 0.25%Cu.

Measuring of ferrite in production welds shall be in accordance with AWS A4.2M:2006 (ISO 8249:2006MOD).

# Weld Controlling - Deltaferrite




*Source:* Figure 1 of AWS A5.9/A5.9M:2006 ERRATA

**Figure A.1—WRC-1992 Diagram for Stainless Steel Weld Metal**

The WRC-1992 Diagram predicts ferrite in Ferrite Number (FN).

The WRC 1992 Diagram is preferred for “300” series stainless steels and for duplex stainless steels. It may not be applicable to compositions having greater than 1% Si

# Weld Controlling – Delta ferrite

Ferrite in welds of austenitic stainless steels can be controlled by one or more of the following methods:

(a) Post weld solution annealing

(b) Use of weld filler with increased nickel content

(c) Increase of nickel equivalent by addition of approximately 1–3 vol.% nitrogen to shielding gas

(d) Selection of heats of materials with high nickel to chromium ratios, such as the European steel grade

1.4435 (see Table MM-2.1-1) with a restricted Cr(eq) to Ni(eq) ratio 3 as per BN2

# Weld Controlling – Delta ferrite

The Basler norm 2 (BN2) describes the special material requirements of 1.4435 according to DIN 17440 with clearly narrowed analysis limits for the alloy components and defined ferrite content ( ferrite ).

Target delta ferrite is 3% at weld joint

**Table MM-5.2.1.2-1 Predicted Ferrite Number (FN) Ranges for Various Austenitic Stainless Steel Product Forms and Welds**

| Product Form | Expected FN |
|---|---|
| Wrought product forms with sulfur levels less than 0.005% | 0.5 to 4 |
| Wrought product forms with a sulfur range of 0.005% to 0.017% | 1.0 to 6 |
| GMAW/GTAW using E316L [Note (1)] | 4 to 12 [Note (2)] |
| SMAW using ER316L [Notes (3), (4)] | 4 to 10 [Note (5)] |
| CF8M and CF3M castings | 5 to 15 |

# Weld Controlling – Delta Ferrite

## Ferritoscope


# Weld Controlling – Tungsten

Angle and profile of tungsten electrode is critical to maintain the weld bead width & profile

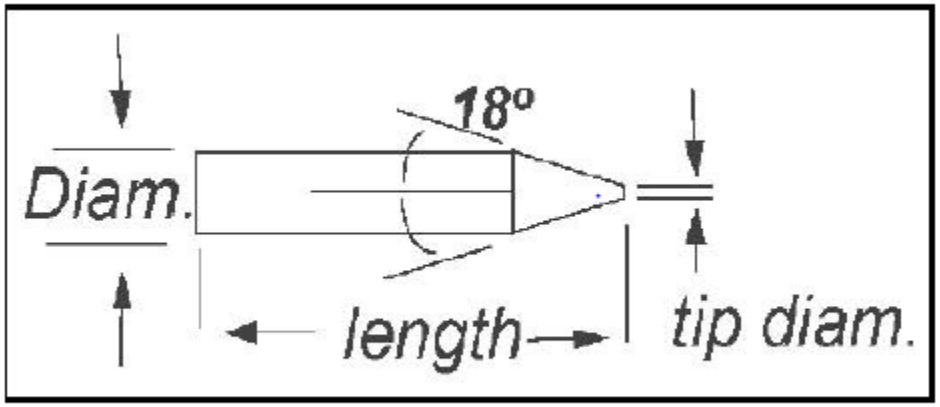



Fig. 11

# Weld Controlling – Welder

- Skilled Welder
- Welding Procedure
- Welder Qualification
- Weld Coupons before job

# Weld Controlling – Surface Treatment

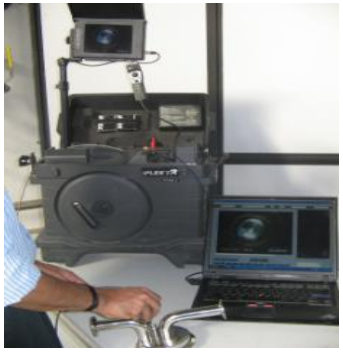
- Passivation
- Electropolishing

# Weld Controlling – NDT

## Radiography

## Dye Penetrant Testing

## Borescope



# Weld Controlling – NDT

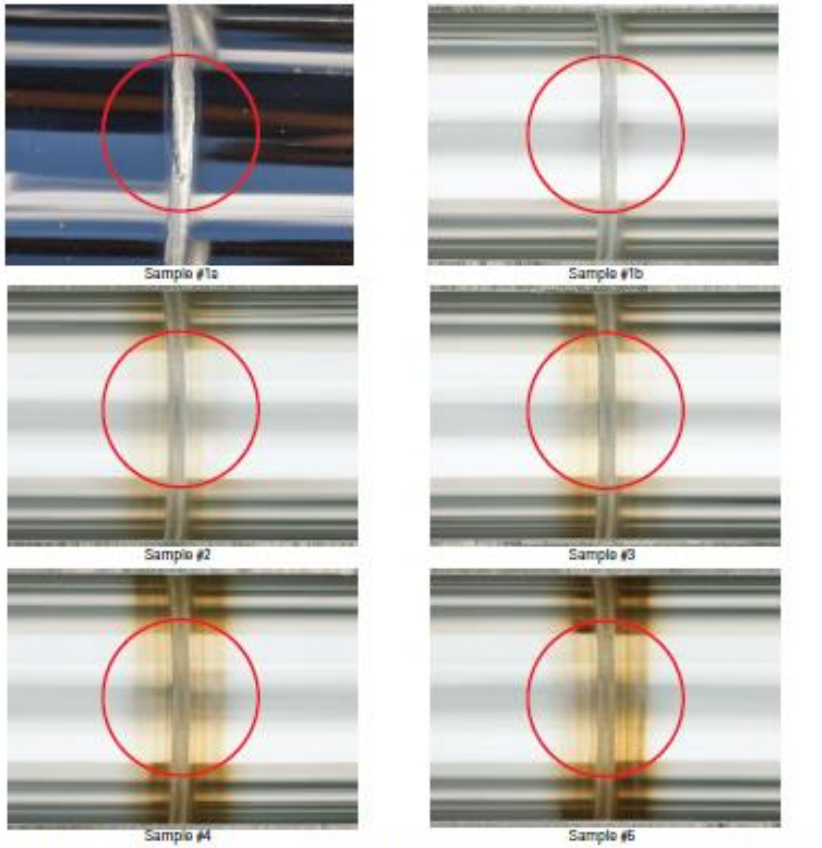





# Weld Controlling – NDT



Fig. MJ-8.4-2 Discoloration Acceptance Criteria for Welds and Heat-Affected Zones on Electropolished UNS S31603 Tubing




The weld beads shown in the above photographs are the weld beads on the I.D. of the tubing. The area for comparison in each photograph is the area inside the red circle. The weld bead shall have no discoloration. Weld heat-affected zones on electropolished UNS S31603 tubing with discoloration levels no worse than Samples #1 through #4 in the as-welded condition are acceptable. Heat-affected zone discoloration levels more severe than that shown in Sample #4 are unacceptable. Sample #5 shows unacceptable weld and heat-affected zone discoloration levels for comparison. The user is cautioned that the colors observed during direct visual examination or borescope examination will be different viewing directly down (90 deg) at the surface compared with viewing at a lower angle along the edges.

GENERAL NOTE: The user is cautioned that electronic versions or photocopies of these acceptance criteria shall not be used for evaluation of sample or production welds since subtle differences in color can influence weld acceptability. Nonmandatory Appendix M explains the technique by which these acceptance criteria were determined.

**This figure is also available as a stand-alone document from ASME as ASME BPE-EP.**

# Weld Controlling – Documentation

Equipment Name:
Equipment Model No:

## CHECKLIST FOR MANUFACTURING DOCUMENTATION OF BIOPROCESS EQUIPMENTS

| -.- | DOCUMENT TYPE | STATUS |
|---|---|---|
| | **VESSEL (shell, lid and internal accessories) >> DOCUMENTS FROM 3rd PARTY** | |
| 1 | MOC Test Certificate for vessel components (contact part and non contact part) | |
| 2 | Dimensional report | |
| | Fit up reports | |
| | Nozzle set up reports | |
| 3 | Welding procedure Qual | |
| | Welders Qualification certificate for welders no: ..... | |
| | Weld drawing | |
| | Weld log sheet | |
| | Quality certificate for TIG electrode | |
| | Quality certificate for filler wire | |
| | Quality certificate for Argon gas purity | |
| | Radiography Test Certificate only for seam welds | |
| | Radiography films | |
| 4 | Dye Penetrant test report for nozzle welds | |
| | Dye Penetrant test report for seam welds | |
| 5 | Vessel Hydro test (procedure + report)-from BZ | |
| | Jacket Hydro test (procedure + report)-from supplier | |
| | Vessel Drainability (procedure + report) | |
| 6 | Ra Report for vessel internal (external optional)- final from BZ | |
| | **PIPES (purchased and used as it is)** | |
| | **In contact with product** / **Not in contact with product** | |
| 1 | MOC Test Certificate / Ra Test Certificate — MOC Test Certificate | |
| | **VALVES** | |
| | **In contact with product** / **Not in contact with product** | |
| 1 | MOC Test Certificate for body / Electropolishing certificate / MOC Test certificate for diaphragm (FDA / USP) — MOC Test Certificate for body | |
| | **MACHINED CONNECTORS / BBL COMPONENTS (steel purchased and transformed at BZ)** | |
| | **In contact with product** / **Not in contact with product** | |
| 1 | MOC Test Certificate for SS / Electropolishing certificate / Nesting drawing / Ra Graphs — MOC Test Certificate for SS | |
| | **EQUIPMENT** | |
| 1 | Weld map | |
| | Weld log sheet | |
| | Weld print outs | |
| | Welders Qualification certificate | |
| | Welding Qualification sample | |
| | Quality certificate for filler wire | |
| | Quality certificate for Argon gas purity | |
| 2 | Passivation report | |
| 3 | MOC Test certificate for piping O ring / gaskets + vessel lid | |
| | **In contact with product** / **Not in contact with product** | |
| 4 | Boroscopy images for process lines: 100% for manual welds, 50% for orbital welds — Boroscopy images for utility lines: Overall 10% | |

SEPARATE FILE: TESTING INSTRUMENTS CERTIFICATES (from supplier + BZ)

| | | |
|---|---|---|
| 1 | Calibration certificate for Ra meter standard piece | |
| | Calibration Certificate for Gauges used for PHT | |
| | Calibration Certificate for measuring instruments (tape / caliper / level) | |

# Weld Controlling – Documentation

## Filler Rod Certificate

ISO 9001:2015 CERTIFIED

No. WL/VW/2018-19/7340

**INSPECTION /MILL/MATERIAL/QUALITY /EN 10204/3.1 CERTIFICATE**

**PRODUCT INFORMATION**

| | | | |
|---|---|---|---|
| CUSTOMER | : BENAKA INDUSTRIAL PRODUCT | GRADE : | ER-316L/1.4430 |
| INVOICE NO. | : 4569/2018-2019 | HEAT NO | : V13129 |
| PRODUCT FORM | : STAINLESS STEEL WELDING WIRE. | | |
| DIMENSION | : 2.40mm Tol :- ±0.05mm | | |
| IDENTIFICATION | : BOX NO. : HH 01-8 | QUANTITY | : 200 KGS |
| CONDITION | : BRIGHT DRAWN & CUT LENGTH (1000 MM). | | |

**CHEMICAL COMPOSITION**

| ELEMENTS | | C% | Si% | Mn % | P% | S% | Cr % | Ni % | Cu% | Mo % | N% | Nb% | Ti% | --- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIFIED | MIN | | | 1.00 | | | 18.00 | 11.00 | | 2.50 | | | | |
| | MAX | 0.03 | 0.65 | 2.50 | 0.03 | 0.02 | 20.00 | 14.00 | 0.50 | 3.00 | | | | |
| RESULTS | | 0.019 | 0.42 | 1.70 | 0.026 | 0.008 | 18.50 | 11.16 | 0.26 | 2.57 | ----- | ----- | ----- | --- |

**MECHANICAL PROPERTIES OF WELD METAL(All Weld)**

| RESULTS | UTS N/mm² | YS (0.2%) N/mm² | R.A. % | ELONGATION % | HARDNESS | |
|---|---|---|---|---|---|---|
| | 577 | 430 | --- | 40.00 | -- | |

# Weld Controlling – Documentation

## Argon Gas Certificate

| Sl.No. | BGL Cylinder No. | Hydrogen |
|---|---|---|
| 1 | BGL13680 | 2.07 % |
| 2 | BGL1530 | 2.08 % |
| 3 | BGL1607 | 2.07 % |
| 4 | BGL12259 | 2.06 % |
| 5 | BGL20746 | 2.07 % |
| 6 | BGL22081 | 2.07 % |
| 7 | BGL2371 | 2.06 % |
| 8 | BGL24347 | 2.06 % |
| 9 | BGL24380 | 2.06 % |
| 10 | BGL24393 | 2.07 % |

Impurities:-
BGL1607 – CH4<0.10 PPM

30 Apr 2019

Q.C. VERIFIED BIOZEEN

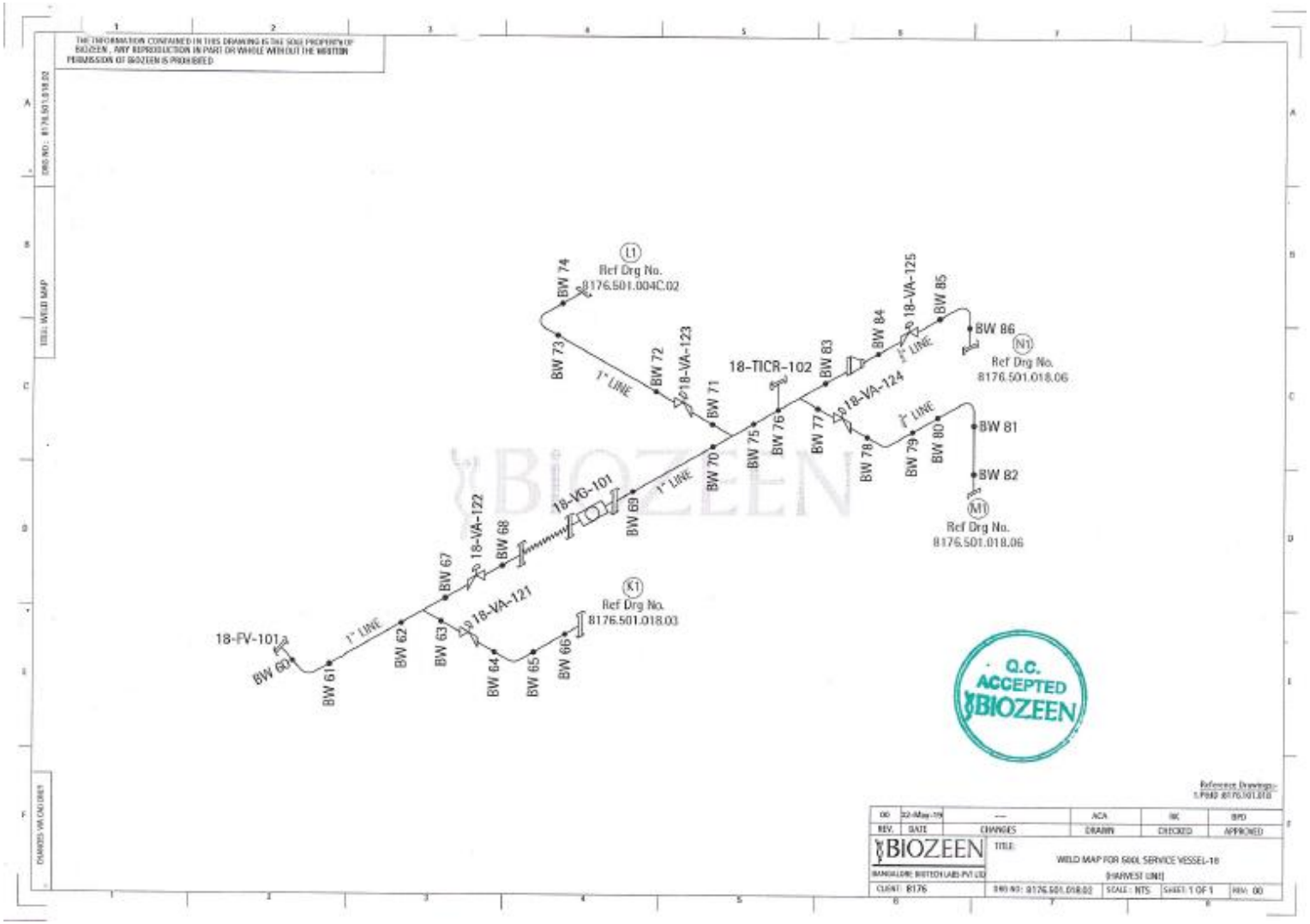
The Concentration of Impurities in this mixture AHM 98:2 are O2<1.0 ppm, H20<1.0 ppm and dew point –76°C. The Concentration of Argon on AHM is 98.0 %.
Remarks: Raw Material Purity – Hydrogen (99.999 %) & Argon (99.9995 %).
Impurities of raw materials are O2<2.0 ppm, H2O<2.0 ppm and THC<0.5 ppm.

**Traceability Certification :**

1. The Product is prepared by using Weight/Pressure Gauge of Accuracy Traceable to National Standards Through Regional Reference Standard Laboratory (Weights and Measures) Govt. of India.
2. The Product is certified using Reference Standard Traceable to NIST/NPL.
3. Process Traceability complying with ISO 9001:2015 Certified System.

# Weld Controlling – Documentation

## Weld Isometric Diagram



# Weld Controlling – Documentation

Weld Log

FORMAT NO:BBL/ENGG-QC/R/WEL.001/R02

BIOZEEN

**WELD LOG** - Harvest Line

| | | |
|---|---|---|
| **Project No. :** 8176 | **Customer :** SERUM INSTITUTE OF INDIA PVT. LTD | **Equipment/System:** 500L SERVICE VESSEL - 18 |
| **Weld Map No. :** 8176. 501. 018. 01 to 06 | **Welding Gas:** ARM | **Welding Procedure:** 001, 011 |
| **P & ID No. :** 8176. 101. 018 | **Shielding Gas:** ARM | |

| Weld no. | Welding Procedure | | Description | Heat no/Lot no: | Welding | | Inspection | | Checked by Welding Inspector & Date | Accepted | | Corrective Action | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Manual | Orbital | | | Date | Welder ID/Sign | Boroscope | Image captured | | Yes | No | | |
| BW 60 | – | ✓ | 1½" Tc x 1" PS | BZ-VI-825/18-19 | 29 APR 2019 | WJ | ✓ | – | 29 APR 2019 | ✓ | – | – | – |
| | | | 1" PS 316L elbow | 469A | | | | | | | | | |
| BW 61 | – | ✓ | 1" PS 316L elbow | 469A | 29 APR 2019 | WJ | ✓ | – | 29 APR 2019 | ✓ | – | – | – |
| | | | 1" PS 316L pipe | 425F | | | | | | | | | |
| BW 62 | – | ✓ | 1" PS 316L pipe | 425F | 29 APR 2019 | WJ | ✓ | – | 29 APR 2019 | ✓ | – | – | – |
| | | | Unequal Tc 1"x½" | 548700/Y8H8 | | | | | | | | | |
| BW 63 | ✓ | – | Unequal Tee 1"x½" | 548700/Y8H8 | 30 APR 2019 | WJ | ✓ | ✓ | 30 APR 2019 | ✓ | – | – | – |
| | | | Diaphragm valve ½" PS | 748146 ATK | | | | | | | | | |
| BW 64 | ✓ | – | Diaphragm valve ½" PS | 748146 ATK | 30 APR 2019 | WJ | ✓ | ✓ | 30 APR 2019 | ✓ | – | – | – |
| | | | ½" SS 316L Elbow | 208575 | | | | | | | | | |
| BW 65 | – | ✓ | ½" SS 316L Elbow | 208575 | 30 APR 2019 | WJ | ✓ | – | 30 APR 2019 | ✓ | – | – | – |
| | | | ½" SS 316L pipe | 547422 | | | | | | | | | |
| BW 66 | – | ✓ | ½" SS 316L Pipe | 547432 | 30 APR 2019 | WJ | ✓ | – | 30 APR 2019 | ✓ | – | – | – |
| | | | ½" Tc x ½" PS | BZ-VI-827/18-19 | | | | | | | | | |
| BW 67 | ✓ | – | Unequal Tee 1" x ½" | 548700/Y8H8 | 30 APR 2019 | WJ | ✓ | ✓ | 30 APR 2019 | ✓ | – | – | – |
| | | | Diaphragm valve 1" PS | 441035 ALR | | | | | | | | | |
| BW 68 | – | ✓ | Diaphragm valve 1" PS | 441035 ALR | 29 APR 2019 | WJ | ✓ | – | 29 APR 2019 | ✓ | – | – | – |
| | | | 1½" Tc x 1" PS | BZ-VI-825/18-19 | | | | | | | | | |
| BW 69 | – | ✓ | 1½" TC x 1" PS | BZ-VI-825/18-19 | 29 APR 2019 | WJ | ✓ | – | 29 APR 2019 | ✓ | – | – | – |
| | | | 1" SS 316L Pipe | 425F | | | | | | | | | |

8176.018 500L SERVICE VESSEL - 18

# Weld Controlling – Documentation

Weld Printout

001 0.5 INC
Pg 01
Number 19

| | | U (V) | I (A) | V rot (mm/min) | V wir () |
|---|---|---|---|---|---|
| | 5s | 0.4 | 0.2 | | 0 |
| | 10s | 0.3 | 0.3 | | 0 |
| | 15s | 0.4 | 0.2 | | 0 |
| S01 | 1° | 10.9 | 49.9 | 21 | 0 |
| | | 10.2 | 17.1 | | |
| | 10° | 10.8 | 49.9 | 90 | 0 |
| | | 10.2 | 17.1 | | |
| | 20° | 10.9 | 49.9 | 90 | 0 |
| | | 10.5 | 17.1 | | |
| | 30° | 11.0 | 49.9 | 90 | 0 |
| | 440° | 9.6 | 22.3 | 90 | 0 |
| | | 10.3 | 10.6 | | |
| | 451° | 10.0 | 18.9 | 90 | 0 |
| | | 10.9 | 9.2 | | |
| | 460° | 10.8 | 15.6 | 90 | 0 |
| | | 11.4 | 8.5 | | |
| | 470° | 11.3 | 13.6 | 90 | 0 |
| | | 12.5 | 7.5 | | |
| | 480° | 11.8 | 10.3 | 90 | 0 |
| | | 12.9 | 6.6 | | |
| | 491° | 13.1 | 7.4 | 90 | 0 |
| | | 13.9 | 5.7 | | |

>>>>>>>>>>>>>>> ! OK ! <<<<<<<<<<<<<<<
Cycle start: Sat 09 Mar 2019 00:24:17
Cycle time : 00:01:18 N = 495

>>>>>>>>>> ! Weld comments ! <<<<<<<<<<

BIOZEEN_W16.8176.010.700L.AV-10
BW-350
09 Mar 2019

# Weld Controlling – Documentation

## Welder Qualification

Designation **Welder Qualification** **BS EN ISO 9606-1 141 PBW FM5 S t1.65 H-L045 ss gb**

| | |
|---|---|
| WPS-Reference: | 004 Rev.01 |
| Welder´s Name: | **Mr. Mansoor Pasha** |
| Identification: | **W12** |
| Method of Identification: | Company Identification |
| Date and place of birth: | 01-01-1985 & Near Bangalore, Karnataka, India. |
| Employer: | M/S. Bangalore Biotech Labs Pvt.Ltd |
| Code / Testing standard: | BS EN ISO 9606-1 : 2017 |
| Remark: | None |
| Job knowledge: | Acceptable |

Examining body : Lloyds Register Verification Limited

| | Weld test details | Range of approval |
|---|---|---|
| Welding process(es) | TIG(141) | TIG(141) |
| Transfer Mode | NA | NA |
| Product type (plate or pipe) | T | T |
| Type of weld | BW | BW |
| Joint type | P BW ss gb | P BW ssmb , P BW bs, P BW ssgb |
| Parent Material group(s)/subgroups | ISO CR 15608 Group 8.1 | ISO CR 15608 Group 8.1 |
| Filler material group (s) | FM5 | FM5 |
| Filler material (Designation) | Solid (S) | Solid (S) , Metal Cored (M) |
| Shielding gas | Argon: Hydrogen Mixture(or equivalents) EN ISO 14175 : AHM | Argon: Hydrogen Mixture (or equivalents) EN ISO 14175: AHM. |
| Auxiliaries (e.g. backing gas) | Argon: Hydrogen Mixture(or equivalents) EN ISO 14175 : AHM | Argon: Hydrogen Mixture (or equivalents) EN ISO 14175: AHM. |
| Type of current and polarity | DCEN | DCEN |
| Material thickness (mm) | 1.65 | 1.65 to 3.3. |
| Deposited thickness (mm) | NA | NA |
| Outside Pipe diameter (mm) | OD 50.8 | OD ≥25.4mm. |
| Welding position(s) | H-L045 | PA , PC , PE , PF |
| Weld details | (ss , gb) | (ss , gb) , (ss , mb) , bs |
| Multi-layer/single layer | sl | sl |

Additional information: available in WPS 004

| Type of qualification tests | Performed and accepted | Not tested |
|---|---|---|
| Visual testing | ☒ | ☐ |
| Radiographic testing | ☒ | ☐ |
| Macroscopic examination | ☐ | ☒ |
| Fracture test | ☐ | ☒ |

Name of the Examiner : D. SUNDARESAN
Place : BANGALORE
Date of issue : 26/04/2018
Signature of Examiner :

Lloyd's Register Verification Limited
DURAISAMY SUNDARESAN
☑ WITNESSED ☐ REVIEWED

# Weld Controlling – Documentation

Welder Qualification

BIOZEEN

**QW-484A - WELDER PERFORMANCE QUALIFICATION (WPQ)**
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

**Welder's name: Mr. Mansoor Pasha** **Identification No. : W 12**

Test Description
Identification of WPS followed: **011 Rev 00 DT 04.01.2017** ☐✓Test Coupon ☐ Production Weld
Specification and type/grade of Base Metal : Thickness : 1.65 mm
ASME SECII PART A.ED.2015 ASTM A 270/SA 213/SA213M
TYPE 316L

Testing Condition and Qualification limits

| Welding variables (QW-350) | **Actual values** | **Range Qualified** |
|---|---|---|
| Welding Process | GTAW | GTAW |
| Type | Manual | Manual |
| Backing | Without Backing | With or Without Backing |
| Plate or Tube | Pipe (OD12.7mm) | Plate & Pipe (OD ≥ 12.7mm) |
| Base metal P- Number to P- Number | P8 to P8 | P1 thro P15F, P34, P41 Thro P49 |
| Filler metal or Electrode specification | None | None |
| Filler metal or Electrode Classification | None | None |
| Filler Metal F Numbers | None | None |
| Consumable Inserts (GTAW or PAW) | None | None |
| Filler type (solid/metal or flux cored/powder) | None | None |
| Deposit thickness for each process | 1.65 mm | 1.65 mm |
| Position(s) | 6G | All |
| Vertical Progression (uphill or downhill) | Downhill | Downhill |
| Type of fuel gas (OFW) | NA | NA |
| Inert gas backing (GTAW, PAW, GMAW) | AHM (Argon 98% & Hydrogen 2%) | AHM (Argon 98% & Hydrogen 2%) |
| GTAW current type | DCEN | DCEN |

# Weld Controlling – Documentation

Weld Coupon

# References


- ASME BPE 2016
- https://www.nickelinstitute.org/media/1702/highperformancestainlesssteels_11021_.pdf
- Guidelines  for the welded fabrication of nickel-containing stainless steels for corrosion resistant services Nickel Development Institute o Reference Book, Series N 11 007
- DESIGN GUIDELINES FOR THE SELECTION AND USE OF STAINLESS STEEL Nickel Development Institute o Reference Book, Series N 9014
- ASME Section VIII (Rules for Construction of Pressure Vessels)
- ASME Section IX ( Welding, Brazing & Fusing)
- ASME Section II ( Materials)

Thank You !