

3-A[®] Accepted Practices for Permanently Installed Product and Solution Pipelines and Cleaning Systems Used in Milk and Milk Product Processing Plants, Number 605-04

Formulated by
International Association of Food Industry Suppliers (IAFIS)
International Association for Food Protection (IAFP)
United States Public Health Service (USPHS)
The Dairy Industry Committee (DIC)

It is the purpose of the IAFIS, IAFP, USPHS, and DIC in connection with the development of the 3-A Sanitary Standards program to allow and encourage full freedom for inventive genius or new developments. Practices for permanently installed product and solution pipelines and cleaning systems specifications heretofore or hereafter developed which so differ in design, materials, and construction, or otherwise, as not to conform to the following practices but which in the manufacturer's or fabricator's opinion, are equivalent or better may be submitted for joint consideration of the IAFIS, IAFPS, USPHS and DIC at any time. NOTE: Use current revisions of editions of all referenced documents cited herein. Standard English is the official language of 3-A Sanitary Standards and 3-A Accepted Practices.

A	SCOPE	B	DEFINITIONS
A1	These 3-A Accepted Practices provide for the installation and mechanical cleaning and sanitizing of rigid pipelines used for milk and milk processing systems in which the connections are welded or are provided with permanently installed CIP fittings. These 3-A Accepted Practices also specify materials, fabrication and other requirements for the rigid cleaning solution lines and for the mechanical cleaning (CIP) unit which circulates the pre-rinse, rinse, cleaning solutions and post-rinse liquids used for cleaning and sanitizing the product pipelines and process equipment. The mechanical cleaning and sanitizing of individual items of equipment may be found in the 3-A Sanitary Standards covering the specific equipment. This practice does not pertain to cleaning systems used on dairy farms, nor to large diameter piping used for conveying dry product in milk drying or instantizing systems. (See Appendix, Section P for an example of a mechanical (CIP) cleaning unit.)	B1	<i>CIP (Cleaned-In-Place)/Mechanical Cleaning:</i> Shall denote cleaning solely by circulation and/or flowing chemical detergent solutions and water rinses onto and over the surfaces to be cleaned, by mechanical means.
		B2	Pipelines
		B2.1	<i>Permanently Installed Product Pipelines:</i> Shall mean rigid pipelines which have welded joints or permanently installed CIP fittings and are designed for CIP cleaning and which are used for milk and milk products
		B2.2	<i>Permanently Installed Solution Pipelines:</i> Shall mean rigid pipelines which have welded joints or have permanently installed CIP type fittings and are used exclusively for the supply and recirculation of cleaning and/or sanitizing solutions, except those used to supply concentrated cleaning and/or sanitizing materials to the point of use.
		B3	<i>Permanently Installed CIP Fittings:</i> Shall mean welded or gasketed fittings designed

- for CIP cleaning which form substantially smooth, flush interior surfaces.
- B4 *Product*: Shall mean milk and milk products.
- B5 *Product Contact Surfaces*: Shall mean all surfaces that are exposed to the product or from which liquids may drain, drop, or be drawn into the product.
- B6 *Solutions*: Shall mean those solutions used for flushing, cleaning, rinsing, and sanitizing.
- B7 *Solution Contact Surfaces*: Shall mean the interior surfaces of the system which are used exclusively for supply and recirculation of cleaning and/or sanitizing solutions, except those used to supply concentrated cleaning and/or sanitizing materials to the point of use.
- B8 *Nonproduct Contact Surfaces*: Shall mean all other exposed surfaces.
- B9 **Mechanical Cleaning (CIP) Unit**
- B9.1 *Mechanical Cleaning (CIP) Unit*: Shall mean equipment assembled as a unit dedicated to and used exclusively for supply and recirculation of cleaning and/or sanitizing solutions. This equipment may include but is not limited to the following:
- B9.1.1 *Solution Pump(s)*;
- B9.1.2 *Solution Tank(s)*;
- B9.1.3 *Solution Supply and Return Valve(s) and Valve Manifold(s)*;
- B9.1.4 *Fittings*;
- B9.1.5 *Solution Contact Heat Exchanger(s) or Steam Injector(s)*;
- B9.1.6 *Instrument Fitting(s) and*;
- B9.1.7 *Strainers*.
- B9.2 The mechanical cleaning (CIP) unit does not
- include utility piping.
- B10 Tungsten Inert Gas (TIG) Method: Shall mean electric welding with a tungsten electrode shielded by an inert gas, to produce a butt fusion weld.
- B11 *Non CIP Appurtenances*: Shall mean those appurtenances such as plug valves, sample cocks, instrument fittings, pumps and parts having the same functional purposes and not designed for mechanical cleaning.
- B12 *Utility Piping*: Shall mean other system service piping such as the steam supply line up to and including the steam supply valve; chemical injection lines up to and including the chemical shut-off device; water supply lines up to and including the water shut-off valve.
- C **MATERIALS**
- C1 The materials of equipment included in the product and solution pipelines and mechanical cleaning units for which there are applicable 3-A Sanitary Standards or Accepted Practices shall comply with the material criteria of the applicable Standards or Practices.
- C2 All other product and solution contact surfaces shall be of stainless steel of the American Iron and Steel Institute (AISI) 300 Series¹ or corresponding Alloy Cast Institute (ACI)² types (See Appendix, Section I.), or metal which under conditions of intended use is at least as corrosion resistant as stainless steel of the foregoing types and is nontoxic and nonabsorbent, or heat-resistant glass piping, except that:
- C2.1 Rubber and rubber-like materials may be used for gaskets, seals and short take-down jumpers.

¹ The data for this series are contained in the AISI Steel Products Manual, Stainless & Heat Resisting Steels, December 1974, Table 2-1, pp. 18-20. Available from the Iron and Steel Society, 186 Thorn Hill Road, Warrendale, PA 15086 (724) 776-9460.

² Alloy Casting Institute Division, Steel Founders Society of America, Cast Metal Federation Bldg., 455 State St., Des Plaines, IL 60016 (708) 299-9160

- C2.2 Rubber and rubber-like materials shall comply with the applicable provisions of the 3-A Standards for Rubber and Rubber-Like Materials Used as Product Contact Surfaces in Dairy Equipment, Number 18-.
- C2.3 Plastic materials may be used for gaskets, seals, sight ports and short take-down jumpers.
- C2.4 Plastic materials shall comply with the applicable provisions of the 3-A Standards for Multiple-Use Plastic Materials Used as Product Contact Surfaces for Dairy Equipment, Number 20-.
- C.3 Utility piping need not be stainless steel
- C.4 Paper gaskets shall not be used.
- D FABRICATION**
- D1 The fabrication criteria of equipment included in the permanently installed product and solution pipelines for which there are applicable 3-A Sanitary Standards or Accepted Practices shall be those of the applicable 3-A Sanitary Standard or Accepted Practice.
- D2 All other product contact surfaces shall have a finish at least as smooth as a No. 4 ground finish on stainless steel sheets, and be free of imperfections such as pits, folds and crevices in the final fabricated form. (See Appendix, Section J.)
- D3 All solution contact surfaces shall be at least as smooth as a No. 4 ground finish on stainless steel sheets, except for those of castings for solution heat exchanger(s)/steam injector(s) and pumps. This does not preclude the use of a No. 2B finish for solution contact surfaces.
- D3.1 The solution contact surfaces of castings for heat exchangers(s)/steam injector(s) and for pumps shall be at least as smooth as ACI Surface Indicator Scale SIS- I . (See Appendix, Section M.)
- D4 Product lines shall comply with the provisions of 3-A Standards for Polished Metal Tubing for Dairy Products, Number 33-.
- D5 Product and solution lines and equipment shall have permanently installed CIP fittings or welded joints. Gasketed CIP fittings shall be readily demountable for inspection.
- D6 Welded joins shall be smooth and free from pits, folds, crevices, cracks, inclusions, or other defects. (See Section G.)
- D7 Removable fittings may be used with or without gaskets and shall be of such design as to form substantially flush interior joints.
- D7.1 Gaskets, when used, shall be self-positioning and form a substantially flush interior joint.
- D8 Power operated solution valves shall have an open space of at least 1 in. (25 mm), clear for inspection, between the actuator and the valve.
- D9 Non CIP appurtenances, such as plug valves, instrument fittings, sample cocks, pumps and parts having the same functional purposes which have product or solution contact surfaces shall be readily demountable and easily disassembled for manual cleaning and sanitizing.
- D10 Radii**
- D10.1 All internal angles of 135° or less on product contact and solution contact surfaces shall have minimum radii of 1/4 in. (6 mm) except that:
- D10.1.1 The radii in gasket retaining grooves except for those for standard 1/4 in (6 mm) and smaller O-Rings, shall be not less than 1/8 in. (3 mm).
- D10.1.2 Smaller radii may be used when they are required for essential functional reasons, such as those in pump impellers. In no case shall radii be less than 1/32 in. (1 mm). The angle must be readily accessible for cleaning and inspection.

D10:1.3	The radii in grooves for standard 1/4 in. (6 mm) O-Rings shall be not less than 3/32 in. (2 mm) and for standard 1/8 in. (3 mm) O-Rings shall be not less than 1/32 in. (1 mm).	E3	Pipelines shall be drainable or self-draining and pitched to drain points.
D11	All product contact and solution contact surfaces shall be cleanable, either when in an assembled position or when removed. System appurtenances shall be accessible for inspection.	E4	Upon completion of welded pipeline installations and prior to use, all interior line and weld areas shall be subjected to circulation of cleaning solution of 0.5 to 1% alkalinity at a minimum of 160° F (71.1° C) for 30 minutes, followed by an adequate post rinse, followed by circulation of 0.5% minimum and 1% maximum phosphoric or nitric acid solution at 150° F (65.6° C) to 180° F (82.2° C) for 10 minutes to clean all interior surfaces of ferric impurities. (This is not intended for passivation.) This treatment shall be followed by an adequate rinse.
D12	Lines and fittings for the application of air under pressure shall comply with the applicable provisions of 3-A Accepted Practices for Supplying Air Under Pressure in Contact with Milk, Milk Products and Product Contact Surfaces, Number 604-.	F	LAYOUT AND ENGINEERING REQUIREMENTS
D13	Nonproduct contact surfaces shall be smooth, free of pockets and crevices and be readily cleanable.	F1	Prior to installation, a drawing or equivalent plan shall be made available to the regulatory agency by the processor for each installation, or subsequent addition or modification, showing each permanent circuit to be cleaned.
D14	There shall be no threads on product contact surfaces or on solution contact surfaces	F2	The mechanical cleaning unit shall be designed so that the suction intake of the primary circulating pump shall be flooded at all times during the cleaning cycle.
D15	Information Plate Cleaning solution pumps designed and used solely for CIP recirculation shall be provided with an information plate permanently affixed to the pump, next to the name plate stating: "This pump shall be used solely for pumping cleaning and/or sanitizing solutions."	F3	Solution temperature shall be automatically controlled by the use of temperature control system with a response range of + 5° F (+ 3° C).
E	INSTALLATION	F4	The mechanical cleaning unit shall be provided with a recording thermometer or similar device complying with these specifications or a recording device which has been reviewed by the FDA and found to provide efficient information to adequately evaluate the cleaning and sanitizing regimen and which is approved by the local regulatory agency shall be installed in the return solution line or other appropriate areas to record the temperature and time during which the line or equipment is exposed to cleaning and sanitizing solutions. The Scale range shall be: 60° F to 180° F (16 to 83° C) with extensions of scale on
E1	Pipelines shall be supported so that they remain in alignment and position. The support system shall be designed so as to preclude electrolytic action between support(s) and pipeline(s).		
E2	Each separate cleaning circuit, including product and solution lines, shall be provided with a sufficient number of access points, such as valves, fittings, or removable sections to make possible adequate inspection and examination of representative interior surfaces.		

either side permissible; graduated in time-scale divisions of not more than 15 minutes. Above 110° F (44° C), the chart is to be graduated in temperature divisions of not more than 2° F (1° C) spaced not less than 0.0625 in. (0.159 mm) apart. Provided that the temperature-scale divisions of 2° F (1° C) spaced not less than 0.40 in. (1 mm) apart are permitted when the ink line is thin enough to be easily distinguished from the printed line. Temperatures shall be accurate within 2° F (1° C) plus or minus, when above 110° F (44° C). The pen-arm setting device shall be easily accessible and simple to adjust. The pen and chart paper shall be designed to make a line not over 0.025 in. (0.635 mm) wide and be easy to maintain. The stem fitting shall have a pressure-tight seat against the inside wall of pipe and no threads shall be exposed to solution. The sensor shall be protected against damage at 212° F (100° C). Circular charts shall make one revolution in not more than 24 h. Strip charts shall not move less than 1 in. (25 mm) per h. More than one record of the cleaning operation shall not overlap the same section of the chart for either circular or strip-type charts.

F5 All connections between any solution circuit and any product circuit shall be effectively separated to positively prevent the commingling of the product and solution during processing. (See Appendix, Section N.)

F6 There shall be no cross-connection(s) between the safe water supply and any unsafe or questionable water supply, or any source of pollution through which the safe water supply might become contaminated. For example, a connection between the water supply piping and make-up: tank, unless protected by an air gap or effective back-flow preventer constitutes a violation of this practice.

G **INSTALLATION WELDING REQUIREMENTS**

G1 All welding of sanitary product pipelines and solution lines shall be made by the TIG

method or an equally satisfactory method. The following precautions shall be taken:

- G1.1 Inert back-up gas shall be used to protect and control the interior of the weld.
- G1.2 The welding surface (interior, face and exterior) shall be cleaned and freed of all foreign matter and surface oxide before welding. Iron-free abrasive shall be used when cleaning surfaces.
- G1.3 All tube and fitting ends shall be square cut and deburred.
- G1.4 Welding procedures shall assure uniform and complete penetration of the weld at all times.
- G1.5 All welds having pits, craters, ridges, or imbedded foreign materials shall be removed and the joints shall be properly re-welded.
- G1.6 Internal and external grinding and/or polishing of pipeline welds is not required. If grinding and/or polishing of external weld surfaces is desired by either the installer or the user, such finishing shall be delayed until after inspection and acceptance of the welding by the applicable regulatory agencies unless internal weld surfaces are easily accessible for inspection.
- G1.7 An acceptable sample weld piece shall be provided when required.
- G1.8 A boroscope or other acceptable inspection device shall be available to use to inspect representative welds.

H **CLEANING AND SANITIZING PROCEDURES**

- H1 A mechanical flushing, cleaning, rinsing and sanitizing regimen which has been demonstrated to be effective shall be employed. Because of the possibilities of corrosion, the recommendations of the cleaning compound manufacturer shall be followed with respect to the time, temperature and the concentration of specific acid or alkaline solutions and

sanitizers. To insure proper strength of solution and to avoid corrosion, the cleaning compound shall be completely dissolved or dispersed prior to circulation. (See Appendix, Section O for one regimen found to be satisfactory.)

- H2 Pulsing of all product outing valves shall be done during each phase of cleaning cycle, ie. rinse, wash, rinse, sanitize.
- H3 A description of the cleaning regimen which has been demonstrated to be effective for each circuit shall be made available by the processor.
- H4 Reverse osmosis permeate or cow water (condensed vapors removed from liquid dairy products by vacuum evaporation) produced in compliance with Appendix D-V of the Pasteurized Milk Ordinance where applicable may only be used as a pre-rinse to drain and to make up cleaning solutions, but cannot be used as the final rinse or to make up sanitizing solutions.

APPENDIX

NOTE: This appendix is an adjunct to the preceding sections of these practices. Its purpose is to provide information and guidance in the design, fabrication and installation of rigid pipelines and cleaning systems.

I

STAINLESS STEEL MATERIALS

Stainless steel conforming to the applicable composition ranges established by AISI for wrought products, or by ACI for cast products, should be considered in compliance with the requirements of Section C.2 herein. Where welding is involved, the carbon content of the stainless steel should not exceed 0.08%. The reference cited in C.2 sets forth the chemical ranges and limits of acceptable stainless steels of the 300 series. Cast grades of stainless steel equivalent to types 303, 304, and 316 are designated CF-16F, CF-8, and CF-8M, respectively. These cast grades are covered by ASTM³ specifications A351/A351M, A743/743M and A744/744M.

J

PRODUCT CONTACT SURFACE FINISH

Surface finish equivalent to 150 grit or better as obtained with silicon carbide, properly applied on stainless steel sheets, is considered in compliance with the requirements of Sections D.2.

K

FLOW RATES

A circulating unit, consisting of a motor driven pump and solution tank, should be provided and deliver a minimum flow rate of 5 ft per sec (FPS) per line when cleaning. In split flow arrangements, a pressure differential should be maintained or flow should be sequenced through multiple paths to assure a minimum flow rate of 5 FPS (1.5 meter per second [MPS]). In all cases, sufficient flow should be maintained to assure that the lines are fully flooded at all times. Table I gives examples of minimum recommended flow rates for CIP systems to meet the 5 FPS (1.5 MPS) mean flow velocity.

³ Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Phone: (610) 832-9500.

TABLE 1: Recommended flow rates to achieve 5 FPS or 1.5 MPS.

Sanitary Tube Size				Flow Rate	
OD	ID	OD	ID		
in.		cm.		GPM	LPM
1.0	0.875	2.5	2.22	9.4	35.6
1.5	1.375	3.8	3.50	24.0	90.8
2.0	1.875	5.1	4.75	43.0	163.0
2.5	2.375	6.4	6.033	69.0	261.0
3.0	2.875	7.6	7.303	102.0	386.0
4.0	3.850	10.0	9.779	182.0	689.0

These flow rates are usually adequate for cleaning pipelines which handle milk and other relatively low-fat products. However, for more viscous products, such as cream, ice cream mix, or concentrated milk products, it may be necessary to change these velocities and/or other cleaning variables. Other variables to be considered are time, temperature, and concentration of cleaning formulations.

L TYPES OF WELDS

L1 *Automatic Weld:* A fully automatic weld is that made by equipment which starts and completes the weld, strikes, and controls the arc with no manual adjustment of control during the welding cycle and will consistently make repetitive welds.

L2 *Semi-automatic Weld:* A semi-automatic weld is that made by equipment which requires manual strike and/or manual control during the welding cycle and will consistently make repetitive welds.

L3 *Hand Weld:* A weld in which the positioning of the arc is manually controlled.

M SPECIFICATIONS FOR VISUAL INSPECTION OF CAST SURFACE FINISH

M1 Because RMS (root mean square) values are applicable strictly to machined surfaces, it is essential to use a scale of cast surfaces in designating the general surface smoothness desired on castings. The reason for establishing a visual standard is to overcome

the obvious inadequacy of any arithmetical or geometrical measuring system when applied to the surface of a casting.

M2 The ACI SURFACE INDICATOR SCALE is the one to be used for the surfaces of castings for pumps or other appurtenances. (See subsection D.3. 1 of these Practices.) The scale provides a measure of the degree of general smoothness which can be attained on alloy castings by currently available processes. There are four surfaces shown on the scale.

M3 Copies of the SPECIFICATIONS FOR VISUAL INSPECTION OF CAST SURFACE FINISH as well as the SURFACE INDICATOR SCALE can be obtained from the Alloy Casting Institute Division, Steel Founders' Society of America, Cast Metal Federation Bldg., 455 State St., Des Plaines, IL 60016, (708-299-9160).

N SEPARATION OF CLEANING AND PROCESSING CIRCUITS

N1 During processing, pipelines and equipment used to contain or conduct milk and milk products shall be effectively separated from tanks or circuits containing cleaning and/or sanitizing solutions (See Section F.5). This can be accomplished by:

N1.1 A complete physical separation of all tanks, pipelines and circuits; or

N1.2 Separation is by at least two automatically controlled valves with a drainable opening to the atmosphere between the valves. The opening to the atmosphere should be equal to the largest pipeline size and the valves should be position detectable. The installation of such valves shall include an automatic fail safe system to prevent product contamination with cleaner and/or sanitizing solutions.

N2 The design of the product and cleaning and/or sanitizing solution pipeline system should provide for the permanent installation of as much of the pipeline as possible.

- N3 All unnecessary bypass and return connections should be eliminated.
- N4 The piping configuration should enable all processing to be completed without piping changes and yet permit quick conversion to cleaning circuits, except for those changes required for separation of Grade A products and non-Grade A products.

**O CLEANING AND SANITIZING
EXAMPLE**

- O1 All solution and product contact surfaces such as down tubes, fill tubes, manhole gaskets, petcocks, plug valves, check valves, instrument fittings and air purgers not designed for mechanical cleaning and sanitizing procedures should be cleaned and sanitized manually.
- O1.1 Immediately after concluding the day's operations, all connections between cleaned-in-place lines and processing equipment which are not included in the cleaning circuit should be removed, the openings capped, by-pass connections made, and the lines flushed thoroughly with tempered water (not to exceed 120° F or 49° C, entering circuit) continuously discarding the rinse water near the downstream end of the solution return line until the discarded effluent is clear.
- O1.2 Circulate an effective detergent solution for a period of time at a concentration and temperature capable of effectively removing the soil residue in the circuit.
- O1.3 Thoroughly rinse the detergent solution from the circuit.
- O1.4 Circulate an acid detergent, when needed, as a supplement to the routine circulation. Follow this acid detergent treatment with a

thorough rinse.

- O1.5 Sanitize all product contact surfaces immediately before use with one or a combination of the following commonly used methods:
- O1.5.1 Circulation of water at a minimum temperature of 170° F (76.6° C) (at the discharge end) through the circuit for 5 minutes and drained.
- O1.5.2 Pumping of an approved chemical sanitizer solution of acceptable strength and recommended temperature through product lines and equipment for at least 1 minute and drained. Halogen based sanitizers (chlorine and iodine) allowed to remain on surfaces for longer than necessary may cause corrosion.
- O1.5.3 Exposure to steam for at least 15 minutes after the temperature of the drainage at the outlet has reached 170° F (76.7° C) or for 5 minutes after the temperature of the drainage at the outlet has reached 200° F (93.3° C)

NOTE: Approved sanitization procedures and related recommendations are provided in detail in the Grade "A Pasteurized Milk Ordinance Recommendations of the U.S. Public Health Service/Food and Drug Administration."

**P SCHEMATIC EXAMPLES OF
MECHANICAL CLEANING (CIP)
UNIT**

These amended accepted practices shall become effective August 20, 1994, at which time the 3-A Accepted Practices for Permanently Installed Sanitary Product-Pipelines and Cleaning Systems, with Amendment, Number 605-03 are rescinded and become null and void.

