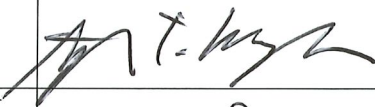








**Standard Operating Procedure**  
**Cleaning Tubing for Process Gas Systems**

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**Approval**

<i>Approving Authority</i>	<i>Name</i>	<i>Signature</i>	<i>Date</i>
Quality Assurance	Steve Washington		15 SEP 2020
Engineering	Steve Rusconi		21 Sept 2020
Process Systems	Ken Anderson		24 SEPT 2020
Service & Safety	Mike Fisher		30 Sept 2020
President	Steve Hansen		6 OCT 2020

**Revision History**

<i>Revision #</i>	<i>Description of Change</i>	<i>Effective Date</i>	<i>DCR#</i>
0	New Document	23 OCT 2020	20001



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- 1 Purpose
  - 1.1 To establish a procedure for Solvent Cleaning Tubing Systems for Process Gas Systems.
  - 1.2 To establish guidelines for the preparation of materials to be installed into Oxygen systems in order to reduce risk of combustion reaction in an oxygen atmosphere and unacceptable product purity.
- 2 Scope
  - 2.1 This procedure applies to Process Gasses including Nitrogen (N<sub>2</sub>), Clean Dry Air (CDA), Oxygen (O<sub>2</sub>) and similar piping requiring high or ultra-high purity installations.
  - 2.2 Solvent Cleaning is the removal of organic contaminations from the surface of SS tubing and fittings using suitable solvents.
  - 2.3 Methods for procuring and handling materials supplied as 'Cleaned for Oxygen Service' (CFOS) from our suppliers.
  - 2.4 Methods for field cleaning and handling materials to be installed as 'Cleaned for Oxygen Service' CFOS.
- 3 References
  - 3.1 Compressed Gas Association Standard for Cleaning Equipment for Oxygen Service (CFOS) CGA 4.1, current edition.
- 4 Responsibilities
  - 4.1 The Quality Control Manager (QCM) is responsible for providing this procedure and guidance to Project Managers and Foreman working on oxygen systems. The QCM shall assist with documentation review and assembly of turnover packages as required.
  - 4.2 Project Manager (PM) is responsible for communicating this procedure to the client and field crews as needed. The PM shall be responsible for the assembly and review of turnover package documentation as required. The PM shall ensure that PPE is available, and all cleaning crews have proper safety training for cleaning as described in this procedure.
  - 4.3 Foremen are responsible for communicating this procedure to the field crews as needed. Foreman shall also ensure documentation is received



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properly and forwarded to the QCM or PM for turnover package assembly as required.

**5 Personnel Safety**

5.1 Cleaning operations for oxygen service equipment shall be carried out in a manner that provides for the safety and health of the personnel performing the work and shall conform to local ordinances and federal state and provincial regulations.

5.2 Instructions and supervision – Operators shall be instructed in the safe use of the cleaning agents including any hazards associated with the use of these agents.

5.2.1 Safety Data Sheet for all chemicals shall be reviewed prior to using the chemicals.

5.2.2 Written instructions shall be issued whenever special safety considerations are involved.

5.2.3 A responsible individual shall direct oxygen cleaning operations.

5.3 Dangerous chemicals - No highly toxic chemicals shall be used.

5.3.1 Special consideration shall be given to the safe disposal of cleaning solution waste.

**5.4 Protective Equipment**

5.4.1 Face shield, goggles shall be provided for face and eye protection from cleaning solutions.

5.4.2 Safety glasses with side protection to protect from injuries due to flying particles.

5.4.3 Protective Clothing shall be provided when required to prevent cleaning solutions from contacting the skin.

5.4.4 Proper gloves should be used.

5.4.5 All work areas where cleaning compounds and solvents are used shall be adequately ventilated.



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5.5 Special Situations

- 5.5.1 Entering vessels and confined spaces. All employees working in or near confined space while hazardous chemicals are in use shall complete Therma confined space training.
- 5.5.2 Confined space entry permits shall be completed as required by owner.
- 5.5.3 Solvents may increase the hazards of the confined space entry, including asphyxiation, toxicity and flammability.

6 Procedures

- 6.1 Therma's project manager (PM) shall manage the purchase of the materials to ensure the tubing, fittings, valves and components are purchased with factory cleaning and certifications as required to meet CGA G4.1 when possible.
- 6.2 Therma's project manager (PM) shall provide the Owner or General Contractor the cleaning material Safety Data Sheets prior to the start of cleaning.
- 6.3 The field foreman shall notify General Contractor, orally or in writing, when said work is to be scheduled and the locations of items to be cleaned.
  - 6.3.1 Foreman shall also coordinate with the General Contractor for receiving inspections by 3<sup>rd</sup> party inspector as required by project specifications.
- 6.4 Therma's field foreman shall plan for proper PPE and safety precautions including ventilation, hot work, etc. as the solvent may have harmful and/or flammable properties.
- 6.5 Generally, the materials should be factory cleaned and this procedure typically then applies in spots where tubing ends are to be joined.
- 6.6 Use pure Isopropyl Alcohol (IPA) solvent or mix Isopropyl Alcohol (IPA) with RO or DI water to achieve approximately 50% concentration in a container or spray bottle as required.



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- 6.7 Use spray bottle or clean room grade wipers to apply the solvent to the area to be cleaned. Excess solvent is removed by gravity drain, evaporation and wiping with low-lint clean room wipers.
  - 6.8 Spray and or wipe the interior surfaces of the area to be cleaned. Constantly fold over the wiper so that the surface is only wiped by clean material. Mechanical energy may be applied by spraying or agitation.
  - 6.9 After cleaning, wipe the area with a clean, dry white wiper to verify the surface is clean. If any debris or color appears on the wiper, continue cleaning until a clean white wiper wipes clean.
  - 6.10 It is vital that all of the solvent be removed from all dead spaces since an explosion could result upon subsequent contact with oxygen.
    - 6.10.1 Pure Nitrogen or Clean Dry Air shall be used to accomplish complete drying of solvent by blowing and/or purging.
    - 6.10.2 If the odor of solvent vapors is detected in the vicinity of the effluent purge gas, the equipment requires additional purging.
    - 6.10.3 Purging can be considered complete when the solvent cannot be detected by appropriate methods in the gas venting from the vessel, piping or component being purged.
  - 6.11 Protection from recontamination – Once an item is cleaned, it shall be protected from recontamination during storage and prior to being placed into service. The protection provided depends on factors such as the type of equipment, length of storage and atmospheric conditions.
  - 6.12 Following execution of this procedure, the Foreman shall visually examine the system to ensure there is no evidence of mill scale or rust on the cleaned surfaces. Therma's field foreman who is working on the jobsite is responsible for ensuring that installers are following this procedure.
  - 6.13 Field foreman shall review the cleaning documents for completeness and submit as required per the project specifications to the project manager.
  - 6.14 Project Manager shall collect the cleaning records from the field and submit them to the customer for record as required per the project specifications.