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Rev	Rev Date	Changes	Approved By
F	6/10/05	Add Training Manuals in References; re format and rename headings for clarification	Kevin Jirak, JoAnn Seuer, Lifang Yan, Fred Simon
G	1/19/06	Reformat, Added sections for: Personnel, Facilities, Utilities, Tools and Equipment, and Documentation; Additional clarification in section 10 with inspection procedures	Kevin Jirak, JoAnn Seuer, Lifang Yan, Fred Simon
H	1/19/10	Update 8.1, 9.1.1, 11.2, 12.5.1, 13.1	Roger Chlan, JoAnn Seurer, Bruce Sanborn
I	4/9/10	Complete rewrite of document to replace NP-004, NP-090, NP-176, NP-200, NP-352 & NP-354	Roger Chlan, JoAnn Seurer, Bruce Sanborn
J	7/6/10	Changes per Praxair: Sections 2.1, 8.1.2, 9.2, 11.1.2, 11.1.3, 13.4	Roger Chlan, JoAnn Seurer, Bruce Sanborn
K	2/2/11	Changes per Praxair: Sections 8.2.1, 9.2	Roger Chlan, JoAnn Seurer, Bruce Sanborn
L	12/14/11	Remove reference to OBS NP-066; add 7.3	Roger Chlan, JoAnn Seurer, Bruce Sanborn
M	5/7/12	Update 7.4; 8; 8.2; 11.1.2	Roger Chlan, JoAnn Seurer, Bruce Sanborn

1. PURPOSE:

This work instruction outlines the processes used to clean, inspect, package and label for Oxygen Service.

2. SCOPE:

2.1 Chart Inc, NP's Standard Practice is to assure wetted surfaces of all products which may be used in storage, distribution and use of Oxygen are Oxygen Clean. This includes surfaces which contact liquid &/or gaseous oxygen whether they are purchased or in-house manufactured components, assemblies and sub-assemblies.

2.2 This procedure is designed to comply with CGA G-4.1 and Praxair GS-38.

3. REFERENCES:

- 3.1 Compressed Gas Association Pamphlet G-4.1
- 3.2 NP-028 NonConforming Material
- 3.3 NP-472 NDT Lighting Devices

4. DEFINITIONS:

4.1 *Oxygen Clean*: Cleaning to ensure that contaminants which may have adverse reactions in an oxygen enriched atmosphere are removed. Harmful contamination would include both organic and inorganic material such as:

- 4.1.1 hydrocarbons, oils or greases
- 4.1.2 paints or fluxes
- 4.1.3 cloth or wood
- 4.1.4 unapproved thread or gasket sealants
- 4.1.5 fibers of excessive size, loose rust, mill scale, shop dirt, filings
- 4.1.6 chips or loose weld splatter
- 4.1.7 cleaning solvents, excessive films or residue
- 4.1.8 (water or excessive moisture due to freezing in cryogenic temperatures)

4.2 *Wetted Surfaces*: Surfaces which contact oxygen - liquid or gaseous.

5. PERSONNEL:

5.1 Only trained personnel, or personnel directly supervised by a trained person are allowed to perform cleaning operations in accordance with this procedure.

Personnel are also required to have apparel which is free of oil and grease, and to perform all procedural operations with clean hands or clean gloves.

6. UTILITIES:

- 6.1 Air and nitrogen used for cleaning and for drying must be dry and completely free of oil.
- 6.2 Water used for making up solutions or for flushing, rinsing and testing shall be tap water of potable quality.

7. TOOLS AND EQUIPMENT:

- 7.1 Tools and equipment used in connection with operations required by this procedure must be free from contaminants and petroleum base products.
- 7.2 Lighting devices used for inspection must comply with NP-472.
- 7.3 Face shield to be worn where solution could splash onto face.
- 7.4 Blacklight
 - 7.4.1 Wavelength between 2500 angstroms and 3700 angstroms
 - 7.4.2 Power greater than 800 uW/cm² at 375mm (typically 50 W min)

8. CLEANING PROCESSES:

8.1 *Cleaning Agents:*

- 8.1.1 Only the following cleaning agents shall be used:
 - Zepride E (Zep Soap) Solution: 1 part Zep to 1 – 5 parts water
 - For large areas, Zep may be applied at full strength to a wet surface
 - For annular pipe flushing, Zep may be used in solution as “weak” as 1 part Zep to 25 parts water. Normally heated to 100°F +/- 25°F.
 - Blue Gold Industrial: 1 part Blue Gold to 10 – 20 parts water
 - Isopropyl Alcohol
 - Ox-Out

8.1.2 The cleaning solution must be changed if it is visually contaminated, or if it is weak (as demonstrated by slow cleaning or repeated verification failures).

8.2 *Cleaning Processes:*

8.2.1 Cleaning processes are designated in the table below:

<u>Component</u>	<u>Cleaning Solution</u>	<u>Cleaning Method</u>	<u>Verification Method</u>
Inner Vessel Heads and Shells	<ul style="list-style-type: none"> • Zep Soap and Water • Isopropyl Alcohol • Blue Gold Industrial 	<ul style="list-style-type: none"> • Scrub wetted surface with brush and cleaning solution • Spot clean with Isopropyl if necessary • Rinse until no evidence of cleaning solution • Dry completely using N2 gas, clean filtered shop air, or by allowing to air dry – there must be no evidence of water 	<ul style="list-style-type: none"> • Visual Inspect: white light • Wipe Test • Visual Inspect: blacklight • Odor test
VIP and Piping	<ul style="list-style-type: none"> • Zep Soap and Water 	<ul style="list-style-type: none"> • Blow solution soaked pigs 	<ul style="list-style-type: none"> • Visual Inspection:

	<ul style="list-style-type: none"> • Isopropyl Alcohol • Ox Out Acid wash 	<p>through pipe until clean</p> <ul style="list-style-type: none"> • Brazed assemblies must be submersed and soaked in acid • Spot clean with Isopropyl if necessary • Rinse until no evidence of cleaning solution • Dry completely using N2 gas, clean filtered shop air, or by allowing to air dry – there must be no evidence of water 	<p>white light</p> <ul style="list-style-type: none"> • Visual Inspection: blacklight • Wipe Test • Odor test
Small Misc Components	<ul style="list-style-type: none"> • Zep Soap and Water • Isopropyl Alcohol • Ox Out Acid wash 	<ul style="list-style-type: none"> • Submerge components in bath of cleaning solution for at least 5 mins. Agitate parts while submersing and removing parts from bath • Spot clean with Isopropyl if necessary • Soak in rinse tub until no evidence of cleaning solution • Dry completely using N2 gas, clean filtered shop air, or by allowing to air dry – there must be not evidence of water 	<ul style="list-style-type: none"> • Visual Inspection: white light • Visual Inspection: blacklight • Wipe Test • Odor Test
Bent Pipe and Tube	<ul style="list-style-type: none"> • Zep Soap and Water • Isopropyl Alcohol 	<ul style="list-style-type: none"> • Flush Zep Soap solution through pipe until clean • Flush with clean water • Dry with N2 gas or clean filtered ship air 	<ul style="list-style-type: none"> • Normally a clean pig is blown through the pipe and then the pig is inspected under white light or black light • Odor test may be used in conjunction with visual inspection

9. VERIFICATION METHODS AND ACCEPTANCE CRITERIA:

- 9.1 An oxygen clean component cannot contain any evidence of oils, grease, loose scale, particulates, fibers, paint, flux, etc. If you can see such contaminants on the part it must be re-cleaned.
- 9.2 Verification of cleanliness can be determined through the use of one or more of the following inspection methods:

<u>Verification Method</u>	<u>Acceptance Criteria</u>
<i>Visual Inspect: white light</i> – Visually examine wetted surfaces under bright light for any evidence of contamination	<ul style="list-style-type: none"> • No evidence of oils, grease, paint, dirt, or crayon marks • No weld slag, flux, metal filings or burrs • Rust or oxide that could flake off must be removed
<i>Visual Inspect: blacklight</i> – Wherever practical, examine in subdued light using a Spectroline Model B-100 SP, B-100A, BIB-150P blacklight.	<ul style="list-style-type: none"> • No smudges, smears, splatters or drops of glowing residue – anything that fluoresces should be rejected • Excessive lint is unacceptable
<i>Wipe Test</i> – Rub surface lightly with a clean, white paper or lint-free cloth. Examine under white and blacklight. The area should not be rubbed hard enough to remove any oxide film since this could be confused with any actual surface contamination.	<ul style="list-style-type: none"> • Visible particles and/or dark smudging is unacceptable • Evidence of oils, grease, or paint are unacceptable
<i>Odor Test</i> –* Blow clean air or N2 through component and gently sniff exhausted gas. Do not inhale deeply. *NOTE: must be used in conjunction with another test.	<ul style="list-style-type: none"> • Any odor of oils, hydrocarbons, or cleaning solutions is unacceptable

9.3 *Other Inspection/Verification Methods:* Upon approval only.

9.4 *Rejections:* The item being examined shall be re-cleaned if found to be unacceptable by verification / inspection method.

10. DOCUMENTATION:

10.1 All inspection and test results shall be documented and identified to items being cleaned.

11. PACKAGING AND LABELING

11.1 *Packaging:* A component must be adequately protected to survive the amount of time and conditions during storage and shipping.

11.1.1 Protection from Contamination: A component must be protected from atmospheric conditions as soon as practical to prevent contamination during storage or during installation.

11.1.2 Protection of Openings: Small to medium sized components must be sealed in new, clean plastic bags. Components that are too large to be bagged must have all openings sealed with clean caps, plugs, or blind flanges. Single layer bags should be 4 mil minimum. Multiple layer bags should total 4 mil minimum.

11.1.3 Pressurization: Components with large internal volumes must be purged with dry, filtered nitrogen gas. A tag indicating item is under pressure with inert gas purge must be attached.

11.2 *Labeling:* After successful cleaning a label shall be placed inside the bag or wire tied to the component and state that it has been cleaned for oxygen service. Additional information on the label could include Operator Number, Part Number, and Date Cleaned.

12. RESPONSIBILITIES:

<u>Department</u>	<u>Responsibility</u>
Design Engineering	<ul style="list-style-type: none"> • Initiate Item Master Descriptions, with proper inspection codes, for all purchased parts, including the verification of O2 compatibility of materials used in Oxygen Service. • Identify components (on drawings &/or WI's) that require tags or labels "CLEANED FOR OXYGEN SERVICE".
Manufacturing Engineering	<ul style="list-style-type: none"> • Complete routings for components and assemblies manufactured in-house which inform personnel of steps required to meet the requirements of CGA G4.1. • Develop, and document procedures for in-house oxygen cleaning, verification, packaging and labeling. • Verify O2 compatibility and approving cleaning agents, sealants and lubricants prior to being used in CHART INC., NP's WI's &/or processes.
Quality Assurance	<ul style="list-style-type: none"> • Review supplier oxygen cleaning procedures and approve if acceptable. Notify purchasing of approved procedure or required improvements. • Audit supplier for adherence to approved cleaning procedure. • Verify/Audit purchased parts for adherence to approved cleaning procedure.
Production/Shop Personnel	<ul style="list-style-type: none"> • Clean, verify, package & label those parts requiring in-house oxygen cleaning. • Maintain oxygen cleanliness during manufacture and assembly. Re-clean those items contaminated during manufacturing. Follow all requirements including those on prints, travelers and work instructions. • Package manufactured components &/or assemblies to maintain cleanliness during storage and shipping.
Purchasing	<ul style="list-style-type: none"> • Obtain oxygen cleaning procedures from suppliers who supply oxygen cleaned parts. • Verify PO's that require supplier oxygen cleaning are issued to approved suppliers. Assure that oxygen clean requirements are communicated to supplier.
Receiving Inspection / Stockroom	<ul style="list-style-type: none"> • Verify that items requiring supplier oxygen cleaning are cleaned, packaged and marked correctly. Inspect items per section 9 and reject those items which do not meet requirements (Ref. NP-028 Nonconforming Material). • Store and handle oxygen clean items such that cleanliness is maintained. Inspect items that have had packages opened, ripped, cut, etc. Reject items which have been contaminated (Ref. NP-028 Nonconforming Material).
Shipping Inspection	<ul style="list-style-type: none"> • Verify oxygen packaging and labeling before release to ship.

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13. VENDOR REQUIREMENTS:

- 13.1 Vendor must develop an internal oxygen cleaning procedure to clean, verify and package oxygen clean components as required by purchase orders. Procedure should meet or exceed the requirements outlined in this procedure and must comply with the requirements of CGA-G4.1.
- 13.2 Submit oxygen cleaning procedure to Chart Inc, NP Purchasing. Revisions to approved procedure must be approved by Chart Inc, NP prior to implementation.
- 13.3 Assure approved oxygen cleaning procedure is followed for all components supplied to Chart Inc, NP as oxygen cleaned.
- 13.4 Permit, on request, Chart Inc, NP representative to audit/inspect vendor cleaning facilities, observe actual cleaning operations and inspect oxygen cleaned items. Supplied parts may be verified/audited for compliance as Chart Inc, NP sees fit.