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	Revision: C	Effective Date: 01/28/08
	Contamination Control and Cleanliness Maintenance	


WORK INSTRUCTION WI (QA)-66

CONTAMINATION CONTROL AND CLEANLINESS MAINTENANCE

Uncontrolled

DOCUMENT OWNER: Tom Donk

DATE: September 21, 2006

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1.0 PURPOSE

This work instruction describes methods and requirements for complete handling processes for ValveTech, Inc. (VTI) hardware. This work instruction is to be used without exception by all ValveTech personnel, suppliers and vendors. **FAA designates Final Assembly Areas. Areas that incorporate laminar flow benches and are certified i.e. FAA room and clean room.**

2.0 REFERENCE DOCUMENTS

The following documents are referenced in this work instruction:

ValveTech, Inc


FORM-116	Repair/Replacement log
FORM-130	Floor Maintenance
P-11	Company Procedure-Non-Conforming Product Procedure
WI(MF)-64	FOD (Foreign Object Debris)
WI(QA)-52	Cleaning and Preservation of Test Fixturing
WI(QA)-43	Cleaning and Preservation of Detail Parts

Federal Standards

FED-STD-209	Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones
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Military Standards

IEST-STD-CC1246	Product Cleanliness Levels and Contamination Control Program
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3.0 MATERIALS

Branson IS Solution - soap cleaning solution

Clean Dry Compressed Nitrogen

Foam

Isopropanol (IPA) - Certified to A.C.S 2-Propanol or as specified on drawing

Kimwipes ®


Liquid Nitrogen (LN₂)

Metal/Plastic Plugs

Nylon Bags

Tape

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3.1 Cleaning Procedure


3.1.1 All ValveTech components are used in critical aerospace applications. Hardware must meet exacting standards of performance and high reliability. In order to meet these standards, cleanliness of the final component assemblies must be built in and maintained through to final assembly and Acceptance Test Procedure (ATP). In order to comply with final cleanliness requirements all ValveTech hardware must be handled and processed in such a way as to eliminate built in contamination resulting from all handling and special processes. All VTI employees and vendors are encouraged to review their handling procedures and provide suggestions to improve areas of weakness and lack of proper definition. The ultimate goal of this procedure is to eliminate, by design complexity and improved methods of handling, all possible sources of contamination.

The following instructions will be employed by all VTI/vendor personnel and applied to their design, handling, and processing of all VTI hardware.

3.1.2 All detail level hardware shall be placed in individual protective containers and/or dividers. These containers will provide protection/separation during handling. The container tops will be retained to prevent unwanted opening and spillage of hardware. The containers shall be cleaned after each use by GN₂ or a simple soap and water solution. When appropriate to place parts in a nylon bag, the bags shall be single use, sealable, and discarded after each use.

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- 3.1.3 Manufacture of hardware (machine detail parts) shall use best practice methods to ensure elimination of all unnecessary burrs and chips etc... Parts shall be free of all burrs and chips prior to entering the VTI assembly process.
- 3.1.4 VTI Engineering will pay special attention to the elimination of areas that can generate or trap contamination such as burrs and chips. Alternative approaches are encouraged in order to control and improve final cleanliness of all hardware.
- 3.1.5 At VTI and vendors facilities, all hardware is to remain in protective containers when not being processed. When detail level hardware is in process at VTI or a vendor manufacturing site, it shall remain in protective containers when not being processed. Hardware having open dead-headed passages is especially susceptible to entrapment of contamination. This type of hardware shall have internal passages protected to prevent introduction of contamination. When the process permits, tape and/or foam/plastic plugs are acceptable. When the process prevents the use of these types of enclosures, metal discs (CRES shims) with retainers (CRES snap rings) will be installed into the bores of these parts.
- 3.1.6 When a specific requirement for a protective enclosure is called out it will appear on the operation sheet for each part of the assembly. All CRES protective hardware can be reused but must be sonic cleaned prior to each use per VTI WI (QA)-43, and stored in clean protective containers to prevent exposure to contamination.

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3.1.7 VTI Fixture drawing number(s) 70785-70788 (Shims) and 70789 (Retaining Rings) are drawings which identify the appropriate part number(s) and the corresponding protective hardware (Shims/Retaining Rings) to be used. Drawing Number 70789 is not formal but is to be used as a guide to select the appropriate protective hardware. Drawing Number(s) 70785-70788 must be controlled for purchasing purposes. These drawings will be periodically re-issued, as required. The drawing(s) will be clearly displayed in all appropriate areas of VTI. It will also be provided to our vendors, as required.

CAUTION: It is mandatory when protective enclosures are required they shall remain installed at all times unless removal is required for processing. All complex subassemblies (bodies, solenoid spool assemblies, etc) shall have the protective enclosures removed only by VTI personnel . Enclosures are to remain installed through sub-assembly testing, coil assembly, heat treatment etc.

CAUTION: Any part(s) having the protective enclosures removed without prior authorization by VTI Q.C. are to be identified immediately by tagging or other obvious visible means. These parts will require special inspection and possible additional cleaning as determined by VTI Engineering and Quality Control (QC).


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Departmental Requirements


The following instructions are additional yet more specific procedures to be complied with by individual groups within VTI, Inc., as well as, VTI Vendors for manufacturing, special processes (welding, heat treatment, passivation, anodize etc.) and testing. Each group will follow the instructions to full compliance without exception. If part(s) fail initially they should be re-inspected after an additional cleaning. Any part resisting cleaning efforts and being unable to pass inspection may be scrapped at the discretion of VTI Engineering and the VTI QC Manager.

3.2 VTI Manufacturing and Vendor Manufacturing

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- 3.2.1 Minimize exposure of all hardware to unnecessary contamination (machine chips and burrs). Keep parts in their protective enclosures and/or covered until actual processing is required.
- 3.2.2 Prior to submitting parts for inspection make sure the parts are free of cutting fluids and are completely burr free. Keep parts in separated and protective containers with dividers to prevent damage.
- 3.2.3 Practice high level machining practices. Use sharp tooling set-up to produce efficient cutting and material removal. Avoid pushing/rolling material. Submit first article(s) for evidence of dimensional compliance with emphasis on burr free parts devoid of machining generated chips and burrs.
- 3.2.4 Avoid complicated/complex configurations by coordinating part design with VTI engineering. Avoid hardware configurations containing operations that produce areas of excessive hanging burrs and entrapment of chips.
- 3.2.5 When possible and/or required, cover all access holes to part(s) to prevent unwanted introduction of manufacturing particulate.
- 3.2.6 When handling parts, hands should be free of dirt, grease, chips, etc. to prevent unwanted introduction of manufacturing particulate.


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3.2.7 Inspection of part(s) shall include an additional cleaning and re-inspection for marginal requirements. At QC and Engineering discretion, scrap part(s) that still do not pass inspection after additional cleaning.

3.3 VTI Inspection

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- 3.3.1 All parts accepted for next operation are to be inspected initially for the presence of chips/hanging burrs. All parts containing these conditions shall be rejected until compliant. All parts not meeting acceptance shall be identified with a conspicuous red tag indicating rejected unusable part(s) per VTI P-11. This tag shall remain with the hardware until repaired. Hardware tagged is not to be used until rework is complete and hardware is approved by VTI Q.C.

- 3.3.2 Avoid damaging finished hardware and critical finishes with inspection equipment such as plug gages. If necessary, the sharp edges of pin/plug gages can be broken/buffed to produce a non-sharp edge. Keep part(s) covered and protected from unwanted Foreign Object Debris (FOD) per VTI WI (MF)-64.

- 3.3.3 Practice good housekeeping and high cleanliness standards. Periodically cleaning the entire inspection department and keeping inspection benches/equipment clean and free of FOD.

- 3.3.4 Verify all parts including subassemblies requiring plugged or sealed bores are compliant for this requirement. Any parts that require protective sealing, and do not comply, shall be cleaned or rejected based on condition. Disposition shall be made by Engineering or QC.

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3.4 Assembly


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Designated areas will be clearly identified by signs throughout the facility. Signs will be clearly posted at the entry points to those areas not permitting food and/or beverage.

3.4.1 All assembly areas are to be kept clean and free of unwanted FOD. Daily cleaning and housekeeping is required with all benches, tooling and inspection surfaces wiped clean to prevent transfer of FOD.

3.4.2 Assembly areas are to be used only for preparation of parts for sub-assembly and final valve assembly. Preparation is limited to examination of detail hardware and measuring for trimming for selective fit. Sub-assembly consists of pressing parts and preparation of solenoid coils etc. During all phases of sub-assembly all parts are to be covered and protected from damage and introduction of FOD.

3.4.3 Maintenance of high cleanliness standards is the highest priority

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3.4.4 Assembly area 1, FAA 1 and FAA2 are not to be used for performing deburr/lapping operations or any process which generates FOD with the only exception being wet lapping of springs to adjust final load. Installation of heli-coils shall be performed with extreme caution. Broken drive tangs must be removed from the assembly bench, safely discarded, and all tangs must be accounted for as stray tangs are a serious contaminant.


NOTE:

WET LAPPING SANDPAPER IS TO BE REMOVED BEFORE IT DRIES.

The following instructions will be employed by all VTI/Vendor personnel.

3.4.5 The deburr/lapping station is located within the prototype machine shop at VTI. The tools/fixtures from this area should not be used in any other area or to perform tasks not relevant with their purpose. It is extremely important to use clean/non-iron bearing tools while deburring/lapping. All tooling used is to be cleaned prior to use and kept in a protective container to prevent wear and damage.


CAUTION: During Pressing Procedure, protect assemblies from contamination that may be generated from the arbor press. Cover the parts with a Kym wipe® or other suitable protective measure, in order to prevent debris from falling into the assembly during pressing operations.

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3.4.6 Special attention must be given while pressing parts together in the assembly process. Internal valve parts such as guide tubes, seats, puck retainers, and welded spool assemblies must have controlled fits of .0002 min. to .0005 maximum or as controlled on the corresponding assembly drawing. Controlled press fits will help prevent hardware damage and/or creating FOD. The use of LN₂ is permitted with Engineering providing the recommended pre-assembly fit dimensions. Press fits should be examined for special tooling to prevent damage due to the press load. All press fit tooling used is to be cleaned prior to use and kept in a protective container to prevent wear and damage. Any special assembly tools created for press fit controls shall be clearly documented and placed on the assembly traveler.

3.4.7 All complex assemblies such as spool assemblies, bodies, etc... shall be sealed with metal shims/retainers immediately after assembly. It is imperative to seal the assemblies immediately after cleaning/assembly in order to maintain internal integrity.


CAUTION: These sealed parts shall remain sealed through all processing and may only be removed to complete the subsequent phases of final assembly. These complex assemblies are to remain sealed at all times unless a process warrants their removal. Removal of any protective enclosures by unauthorized personnel is not permitted without written approval of VTI Q.C. Department.

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3.4.8 All parts and assemblies that are in process shall be covered and protected with clean (single-use) Kym Wipes® or other suitable protective measures. All space assemblies ready for final assembly shall be moved and stored in the FAA until completion of final assembly.

3.4.9 After completion of final assembly and prior to testing, all valve ports are to be sealed and protected. Threaded ports can be taped, sealed with foam and/or approved metal/plastic plugs. Tubes and non-threaded connectors can be sealed with single use clean room foam and tape. All electrical connectors are to be covered to prevent internal/external damage.

3.4.10 The FAA shall contain storage shelves and a grade 100 Laminar Flow Bench. All tools and inspection equipment designated for the FAA shall remain in that area and not be used for other unrelated operations. The FAA area shall be routinely cleaned and all surfaces wiped daily. Benches shall remain clear of all unnecessary tools and equipment and only hardware/tools for the current job being assembled will be on the bench. Floors are to be swept and mopped once a week minimum and a record kept on Form-130.

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FOD generating activities are NOT to be conducted in the FAA. When not in use the FAA shall be locked with access given to the Assembly Manager and to the Operations Manager with consideration for entry by appropriate employees for off-work hours the integrity of the FAA area is of the highest priority.

3.5 Test


CAUTION: ALL Food Must Remain in Pre-Approved Designated Areas ONLY...NO EXCEPTIONS.

3.5.1 All testing shall be appropriately performed in the Pneumatics Test Labs or the Hydraulics Test Lab. Additional testing may be performed in the Development Area when approved by Engineering and QC.

3.5.2 All test labs are to be clean and well organized. Daily cleaning of test benches is required. Floors are to be mopped once a week minimum and recorded on Form-130. Nothing is permitted in the test labs except valve hardware, fixtures, tools, and inspection equipment. Daily housekeeping, applies to fixturing, fittings, tools, and inspection equipment. When these items are not in use, they will be stored in their appropriate area in clean protective containers. Fittings shall be separated to prevent damage and contamination.

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- 3.5.3 **All plumbing (fittings, valves, fixtures) are to be cleaned and visually inspected prior to each use.** Periodic inspection of standard fittings and multiple use tooling/fixtures shall determine any damage or conditions that could affect the integrity of the test set-up. Repair or replace this hardware prior to use. It is mandatory for all tooling and fixtures to be re-inspected when returned to stock. An inspection verification record shall be provided by VTI Q.C. and maintained by all users of the equipment and recorded on FORM-116.
- 3.5.4 All test set-ups will be constructed with safety and cleanliness as the primary requirement. When possible avoid threaded fittings. **It is mandatory to filter all ports leading to the valve internals.** Filters will prevent the inadvertent contamination of the valves. If and when a possible backflow condition can occur, it is necessary to filter the outlets as well. All fittings, valves, tubing etc shall be CRES, when possible. Non-CRES materials that come in contact with test fluid media shall be avoided whenever possible. All fittings shall be kept clean and free of contamination/oxidation. Any fitting that shows excessive contamination after cleaning or have damage shall be repaired or replaced per VTI Q.C.
- 3.5.5 Great caution shall be used in maintaining test fixtures and filters. Prior to use all fixtures/filters will be cleaned with WI (QA)-52 and WI (QA)-43 when filters require maintenance they are to be discarded and replaced with new filters and FORM-116 should show a record of replacement. In some instances, it is appropriate to leave fittings installed in test fixtures. The reduction of installation/removal of threaded fittings will help reduce particulate generation. Fixture/fittings that are to remain assembled shall be clearly marked/tagged or

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lock-wired together. These assemblies may be periodically disassembled for more intense cleaning and maintenance.


3.5.6 When not installed in a test set-up, all valves will be protected by sealing valve openings (tape/foam) or protected in a plastic container or on a laminar flow bench to prevent exposure of possible FOD.

3.5.7 After complete testing of sub-assemblies or final assemblies, if they require further processing such as welding, heat treatment, vendor processes, all parts and assemblies shall be covered and protected. All space valve assemblies ready for final assembly shall be moved and stored in the FAA until completion of final assembly.

The following instructions will be employed by all VTI/Vendor personnel and applied to their design, handling, and processing of all VTI hardware.

3.6 Shipping and Receiving

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CAUTION: All Hardware will be inspected, visually by Shipping and Receiving Department. If a non-conformance issue arises, Shipping/Receiving will visually Tag hardware in question, and then notify QC. Quality Control will work with Program Manager toward the best possible solution, and full compliance with this procedure.

3.6.1 As detail hardware arrives in from vendors/suppliers, they will be individually packaged or placed in divided containers with retained lids to prevent contamination during shipment from/ arrival to VTI. Only approved packaging may be used. The same applies to any hardware leaving VTI premises. If a shipment arrives without following the proper procedure, immediately visually identify (tag) the hardware in question, and involve QC and the Program Manager. QC will dictate the necessity for possible additional cleaning processes to guarantee their cleanliness, as required.

The following instructions will be employed by all VTI/Vendor /Customer personnel and applied to their design, handling, and processing of all VTI hardware.

3.7 Stockroom

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3.7.1 It is necessary to store all critical hardware separated in divided containers. The containers must have secured lids to alleviate the threat of contamination while waiting shipment/next process. The bores need to be protected by plugs/clean room tape with foam before placing into stock. Detail hardware that is removed from stock must be cleaned and inspected per WI (QA)-43 prior to next operation. When stocking complex parts/assemblies, always store open bores (dead-headed) face down to mitigate entry of particulate.


3.8 Vendors and Suppliers

3.8.1 All suppliers of ValveTech will comply with the same requirements defined by this procedure when applicable.

3.8.2 The primary requirement of this document focuses on prevention of damage due to improper handling and introduction of FOD to our hardware.

3.8.3 As suppliers to VTI, it is mandatory all vendor employees are responsible for the handling and processing of our hardware. It is necessary to do so under the same conditions imposed on VTI employees.

3.8.4 This procedure will be a requirement shown on all purchase orders involving vendor hardware manufacturing, testing, and special processes.

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3.8.5 If any requirement defined by this procedure cannot be complied with, the supplier shall stop all work and contact VTI Purchasing and/or Q.C.

3.8.6 Attached to this procedure are a series of drawings sketches depicting various VTI detail parts. These depictions are intended to define part complexity so a general understanding can be conveyed for different levels of handling and contamination control.

Procedure Review and Maintenance

The senior staff representing Engineering and Manufacturing will meet quarterly and discuss the contamination/cleanliness procedure and its effectiveness. Modifications and improvements to the procedure are encouraged for overall continuous upgrading of all process.

An auditor with the background and experience shall be appointed to conduct a review of all areas covered by this procedure. An audit shall be conducted quarterly with the results reported to the QC Manager for review and disposition.

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Three categories of parts will be shown:

- a) Simple no complex parts having no internal passages for FOD entrapment

- b) Semi-complex parts having internal passages capable of FOD entrapment with a low probability

- c) Complex parts having very intricate internal passages with a high level of probability for entrapment of FOD.

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Category I

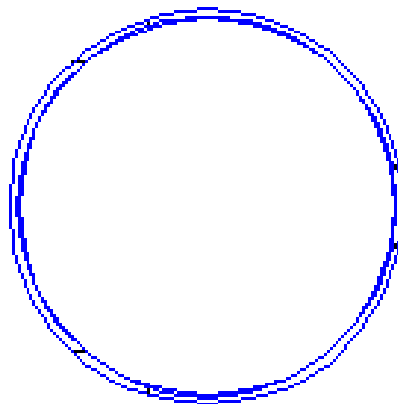
Simple non complex parts- Retainers, springs, guide rings, guide tubes, open spool assemblies, straight thru tube assemblies, fittings, endplates, cores, headplates, core headplate weld assemblies.

Category II

Semi Complex Parts: Seats, plungers, stops, filters, right angle tubes, solenoid coil assemblies, bellows.

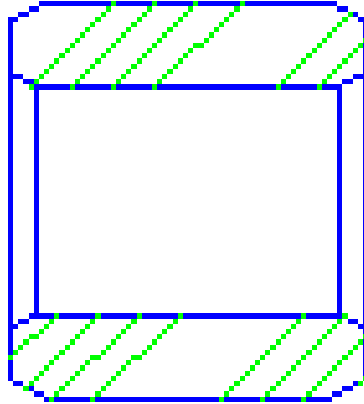
Category III

Complex Parts: Ported bodies, final spool assemblies, plunger assemblies, plunger assemblies, spool/sleeve assemblies, bellows/header assemblies.



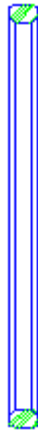
Spacer/Category I- simple 24074

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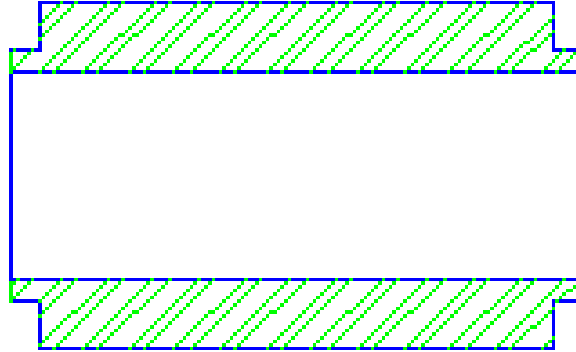
Shaft Guide/ Category I- simple

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Guide Ring/Category I-
Simple P/N 24025

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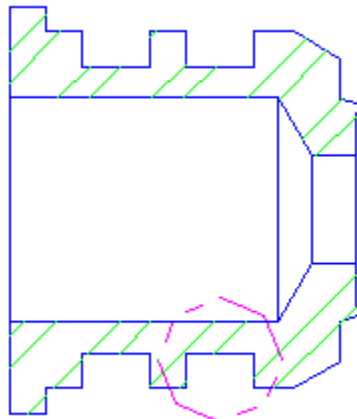


Core/ Category I-simple



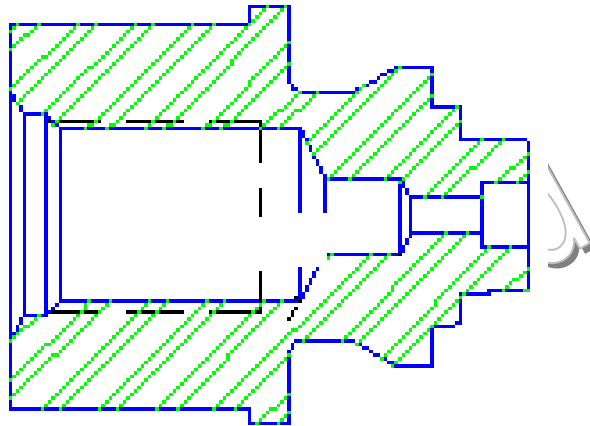
Poppet Shaft/Category I-Simple P/N 23674

Unclassified



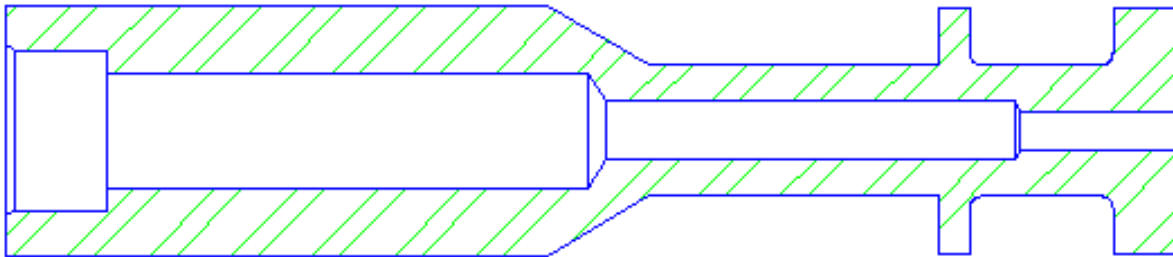
Seat/ Category II-semi-complex

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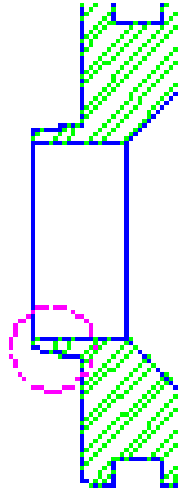
Poppet/Category II-
Semi Complex P/N
23661

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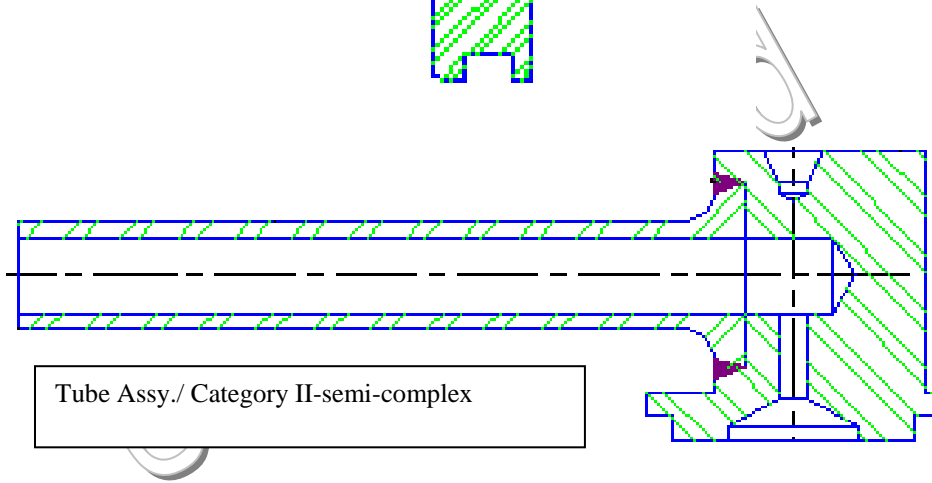


Plunger/Category II- semi-complex

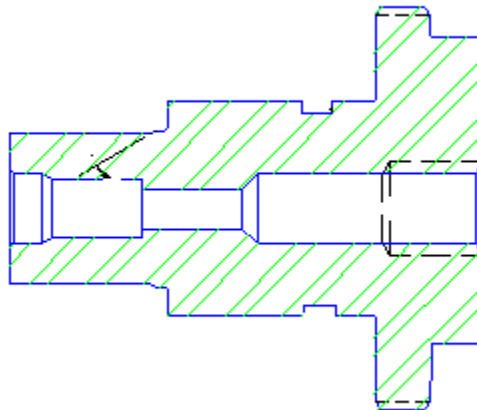
**Contamination Control and
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Bellows
Header/Category II-
Semi Complex P/N
24042

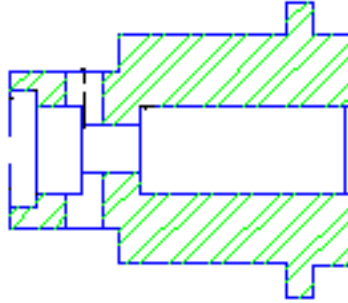


Tube Assy./ Category II-semi-complex

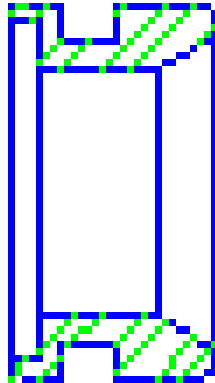


Endplate/Category II-
Semi-Complex P/N
24088

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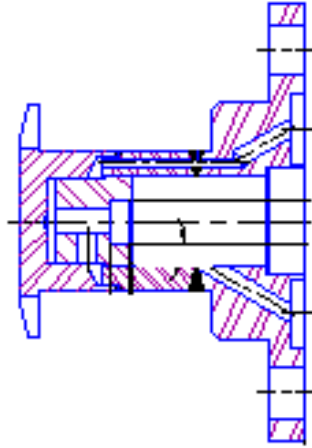


Plunger/Category II- Semi
Complex P/N 24098

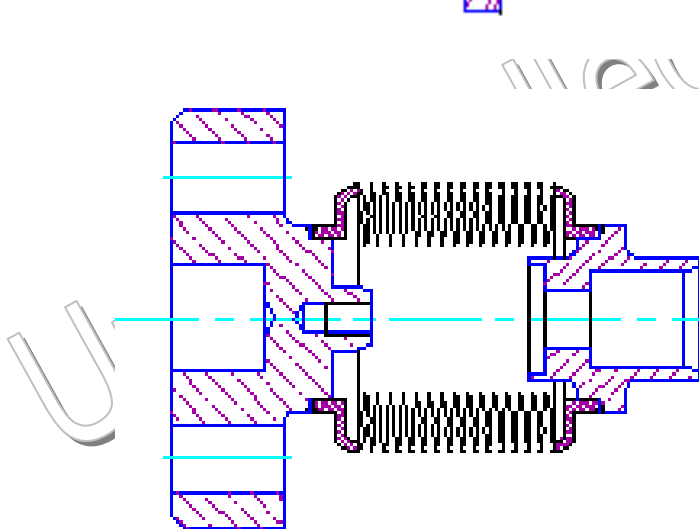


Seat Retainer/
Category II-semi-
complex

**Contamination Control and
Cleanliness Maintenance**

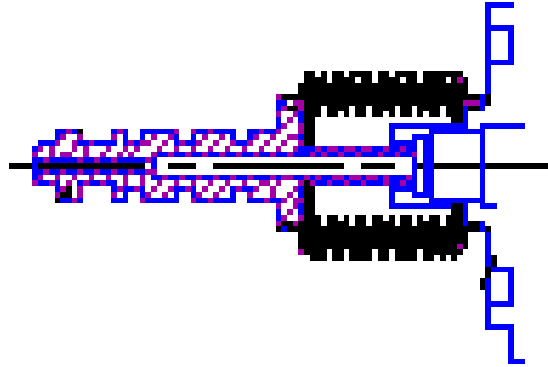


Stop Plate
Assy./Category III-
complex P/N 24235

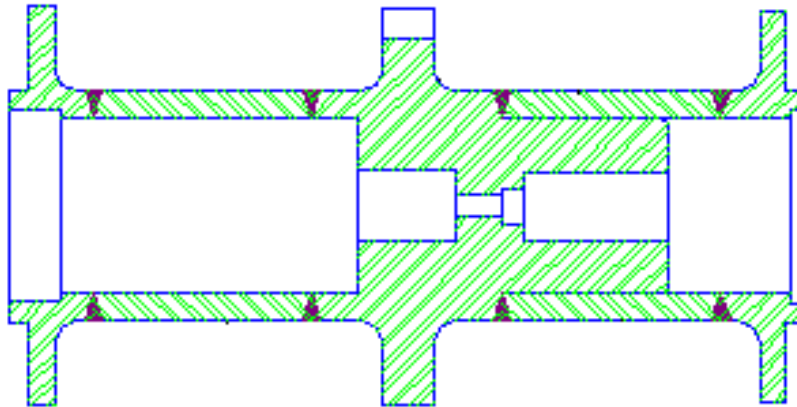


Bellows Assembly/ Category
III- complex

**Contamination Control and
Cleanliness Maintenance**

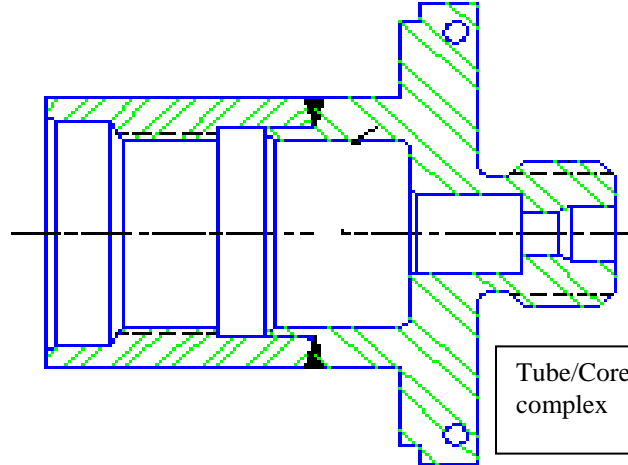


Upper Bellows Assy./Category III-
Complex P/N 24011



Spool Assy. Weld/ Category III-
complex

**Contamination Control and
Cleanliness Maintenance**



Tube/Core Assy./ Category III-complex

Uncontrolled