International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 01, January-2019

MANFACTURING PROCESS PLAN OF LATCH AND SOLENIOD VALVES USED IN SATELLITE CONTROL VALVE

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Abstract: ***Satellite control valve technically known as Latchable series redundant valve finds application in both GSLV and PSLV. Generally each satellite employs 16 engines. Each engine of satellite has 2 satellite control valves which are responsible for controlling the movement of satellites in required orbit. So on a total there will be 32 LSRV's for any satellite which serves for 15-20 years in space. According to the requirement these valves will actuated automatically through control systems and sensors. The Valve is proposed to be used in the 22N and 10N thrusters of GEOSAT propulsion systems for propellant flow control***.

Keywords— Latch Valve, Solenoid Valve & Manufacturing Process.

I. INTRODUCTION

In Latchable Series Redundant Valve, two valves are located. Latch Valve and Solenoid Valve. In one satellite 32 LSRV valves are used. These valves are used to monitor the controlling of the satellite. In this valve the fuel used is Mono Methyl Hydroline. They are separate tanks for the stages and LSRV sopping the fuel to separate in the fuel tanks. These 35000 are good operated to control the lam valve for 1 satellite 2 lam valves are used. In a satellite 16 Engine are used for each 2 LSRV valves are used. The life span of an valve is 20 years. When the satellite goes upwards then after reaching the point if any desirable occurs in the orbit. The LSRV valves are used.

II. OPERATIONAL DETAILS OF LATCH VALVE

Fig.1 starting stage of Bobbin before winding

Fig.2 Hydraulic and Pneumatic Leak Test

Fig.3 Fixture Mode Assembly of Latch Valve Bobbin

III. PNEUMATIC TEST

Pressurize the assembly for positive pressure with HE gas and immerse bobbin in water and pressurize gradually to 20bar and hold it for 5 min. During holding time observe for any leak or bubbles from the bobbin**.**

COIL WINDING & PREPARATION OF BRAZING

Carry out coil winding as per document**.**

Fig.4 Winding

Fig.5 Cover assembly after Brazing

Carryout brazing of the parts that is solenoid cover and lead wire bush. Clean solenoid cover and lead wire bush by using IPA. After assembly fix the solenoid cover sub assembly to the base plate and send for brazing**.**

IV. ASSEMBLY OF MAGNET, COVER SUB-ASSEMBLY TO BOBBIN

Clean the EB Weld joint region of bobbin, slot for magnet and solenoid cover assembly with acetone. Assemble the five arc shaped permanent magnets in the circumferential slot provided in the solenoid bobbin. Ensure that the magnets are not damaged or having broken ends. Assemble the cover with the bobbin. Carryout the measurement of coil resistance at 100VDC. Clean the bobbins by wiping using acetone as medium at EB Welding zones. Dry the bobbin in vacuum dryer. Then release for EB welding using certain depth of penetration at one joint and the other joint is fillet weld for fusion. After EB welding visually inspect weld zone and lead wires.

Fig.6 Flexure Pack Calibration

Fig.7 Plunger Stroke Measurement

PLUNGER STROKE MEASUREMENT SET UP

Record the Identification number of all parts going into each valve assembly in logbook and parts identification sheet. Identify the solenoid bobbin sub assembly part No.19 and plunger part No.2, solenoid core part No.6, plunger spacer (inlet & outlet) part No.3, flexure spacer inner (inlet & outlet) part No.9, flexure spacer outer(inlet & outlet) part No.8, plain washer part No.5, plunger part No.11, flexures(inlet & outlet) part No.10.

Visually inspect the solenoid bobbin sub assembly under 20X magnification. Clean the plunger seating area and plunger OD with IPA, using lint free cloth. Ensure no metallic particles are sticking to bobbin bore. Clean all the parts ultrasonically in IPA except bobbins, for 5 minutes. Assemble the plunger and solenoid core to the bobbin.
Assemble flexure, flexure spacer inner, flexure spacer outer, plunger spacer, plain washer**,** plunger nut with Dummy seal carrier body. Hold the Dummy seal carrier body hexagon with spanner and tight the M4 Nut by applying a torque of 20 kg-cm. Apply 15 VDC to the coil and actuate the valve 5 times. Keep the plunger in closed position. Plunger stroke (Sp) shall be 0.55 to o.58 mm. If the plunger stroke is found within the specified limits, then go for latch force measurement**.**

LATCH FORCE MEASUREMENT

Keep plunger in closed position. Using spring calibration machine (digital) of range (0-20) kgf .To load the latch force measurement in to seal carrier dummy. Value of F0 shall be 2.7 kg minimum and 3.6 kg maximum. After the latch force measurement, preserve the plunger, flexures, flexure spacers, plunger spacer and the bobbin assembly as set.

PREPARATION OF SEAL CARRIER BODY SUB ASSEMBLY

Verify the QA clearance of all the parts. Inspect the valve seal under 40X magnification and check for surface defects, like scratches, peel off if any. Then tie the parts seal carrier body, seal holder and retainer ring with SS wire as a set. After tie up the seal carrier body sub assembly sent to water jet cleaning, GN2 purging, vacuum drying and send for passivation**.**

SEAL CARRIER BODY CRIMPING

Examine the valve seal (Teflon seal) under 40X magnification for surface defects, cross line & peel off etc. After passivation carry out jet cleaning with DM water of seal carrier body surface parts GN2 Purging , vacuum drying. Using tweezers place the seal in the seal holder such that its better surface is at the top and press it into the holder applying light pressure. Inspect using microscope to see whether the seal is inserted into the seal holder completely or not. Assemble the spring into the seal holder and push it into the seal carrier body**.** Place the retainer ring in the specified bore of seal carrier body and using the press fitting tool, press fit the retainer ring into the seal holder. Check under microscope whether retainer ring is properly fitted or not. Using the crimping tool crimp the diameter 6.5 edge of the seal carrier body onto the chamfer of retainer ring. The crimping should be done using the precision vice in the clean room. The load should be applied by turning the vice handle with hand. lever operation is not permitted. Visually inspect the crimping under 40X magnification.

BUBBLE POINT SET UP FIXTURE MODE ASSEMBLY

Carryout the visual inspection of filter elements. Verify the water level equal on both sides of manometer. Slowly apply the minimum positive pressure till the bubble comes from filter element. Record P (pressure difference) in manometer when first bubble comes from filter element.

V. **FILTER SUB ASSEMBLY**

Fig.8 Filter sub assembly

Verify the system readiness like gauge calibration availability for DM water and nitrogen gas precision vice and fixtures. After deburring clean the filter holder ultrasonically with Trichloroethylene for 5 minutes, in pre clean room. Clean the parts with water jet DM water at a pressure of 5 to 6bar. Assemble the filter into filter holder**.** Before EB welding clean the weld zone using Acetone dipped lint free cloth.

BUBBLE POINT TEST FOR FILTER SUB ASSEMBLY AFTER EB WELDING

Receive filter sub assemblies after EB welding. Visually inspect the filter sub assemblies. Verify the calibration of pressure gauges. Clean the EB weld zone (where inlet tube gets welded). Using lint free cloth dipped in acetone. Clean the filters sub assemblies by wiping using acetone as medium**.**

EB WELDING OF INLET FITTING WITH FILTER SUB ASSEMBLY

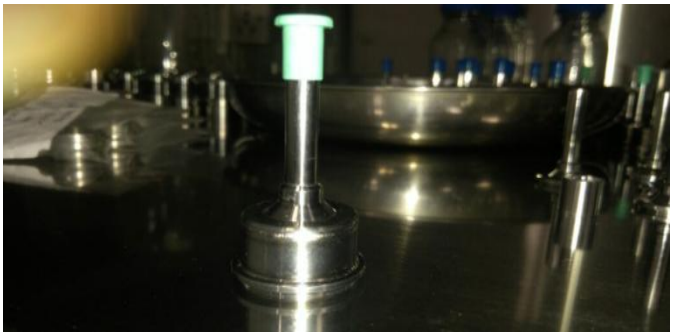


Fig.9 EB Welding of Inlet Fitting with Filter Sub Assembly

Clean the inlet tube ultrasonically with IPA for 5 minutes. Carryout the inspection under 20X magnification. Clean the EB welding joint regions of filter sub assembly and inlet tube using lint free cloth dipped in acetone. Carryout EB welding with DOP. After EB welding of inlet tube sub assembly, clean EB weld area with acetone then inspect EB weld joints. Release for flushing of inlet tube surfaced

FLUSHING OF INLET TUBE SUB ASSEMBLY

Check the readiness of the system, fixtures filtered with IPA 0.45µ filter. Collect the IPA about 2 to 3 litres for one inlet fitting sub assembly. Release the Inlet fitting sub assemblies for passivation.

EB WELD JOINT GAP MEASUREMENT INLET AND OUTLET SIDE

Assemble the plunger, solenoid core, seal carrier sub assembly, flexures, flexure spacer outer and plunger spacer. Subsequently assemble the inlet side plunger spacer, flexure, flexure space outer, flexure spacer inner, plain washer**,** plunger nut**.** Measure the EB weld gap at inlet and outlet side. That should be a positive visual gap not exceeding 40µ. If outlet gap is more than 40µ, use a thinner gap adjusting spacer. If gap is not visible on the inlet side, use a thicker gap adjusting spacer and rechecked.

VALVE STROKE MEASUREMENT AND CORRECTION

Fig.10Valve Stroke Measurement and Correction

Carryout the valve assembly. Keep valve in closed position. Now activate the valve to open applying 14V across the open coil. Repeat the trial for repeatability. If the valve stroke is within the limits, go for the passivation internal parts. Passivate all stainless steel parts and tie with SS wire that is plunger part, solenoid core part, outlet side plunger spacer part, outlet side flexure part, flexure spacer inner part, flexure spacer outer part, outlet fitting port, gap adjusting spacer. Tie the inlet side plunger spacer, flexure spacer outer part, flexure spacer inner part, plain washer part**,** plunger nut part, gap adjusting space part, as a set and send for passivation

CONTAMINATION CHECK OF INLET TUBE- SUB ASSEMBLY & PREWELD ASSEMBLY TEST

Fig.11 Contamination Check of Inlet Tube- Sub Assembly

Fig.12 Pre weld Assembly Test

Contamination check is to be done just before the fixture mode assembly. Carryout the contamination check of the collected sample using PAMA's liquid borne particle counter. After met the specified contamination purge the inlet fitting sub assembly with GN2 at 5bar till compete removal of IPA traces**.** The accuracy of the machining is graced over due to the occurrence the minimum tolerance. As in the sub assembly the tolerance is very minute as the sub ordinate in the assembly The each and every specimen is compelety inspectioned and then the correction is made upon.

VI. ELECTRICAL TESTS EQUIPMENT

Objective of these tests is to check whether the valve meets the basic functional requirements prior to EB welding. Visually examine all critical parts. The Teflon seal surface and outlet fitting seat is to be inspected under 40X magnification for good surface finish. Complete the fixture mode assembly. Then go for the pre weld test**.**

MEASUREMENT OF COIL RESISTANCE & NO LOAD ACTUATION

Measure and record the coil resistance using a digital millimeter**.** Apply 14 VDC pulse across solenoid coils and actuate the valve for 10 cycles. Check whether valve actuation sound is clearly audible**.**

PULL IN VOLTAGE AT NO LOAD (OPENING COIL) & RESPONSE TEST

Note the voltage at which opens with clear audible sounds of opening**.** Apply 9 VDC across the closed coil and increase the supply voltage in steps of 0.2v. Note down the voltage at which valve closes with clear audible sound**.** Determine the valve opening response from the current trace frozen in the oscilloscope for closing response mode**.**

MEASUREMENT OF COIL RESISTANCE & INTERNAL LEAKAGE TEST

Using high resistance meter, measure the coil insulation between the valve body and shorted ends of the coil at 100v,Insulation resistance shall be more than 5*10^7 ohms**.**

Fig.13 Internal Leakage Test

Calibrate the MSHLD with standard leakage calibrator. Mount the valve outlet onto the MSHLD evaluation port, evacuate the MSHLD, pressurize the valve inlet at 0.5 bar with GHe, Note the internal leakage at 0.5 bar at 3 minutes. Increase valve internal pressure to 17.5^+/-0.2 bar. Note the internal leakage at 17.5 bar.

FINAL CONTAMINATION CHECK

Pressurize the inlet pressure to 10 bar. If acceptance test results are found satisfactory, valve shall be delivered for LSRV EB Welding. During shortage period, valve shall be kept in clean room and close the inlet and outlet with plastic caps.

FINAL STAGE OF LATCH VALVE:

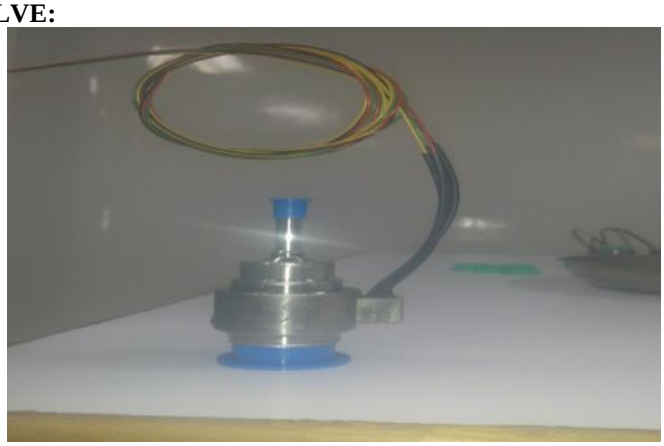


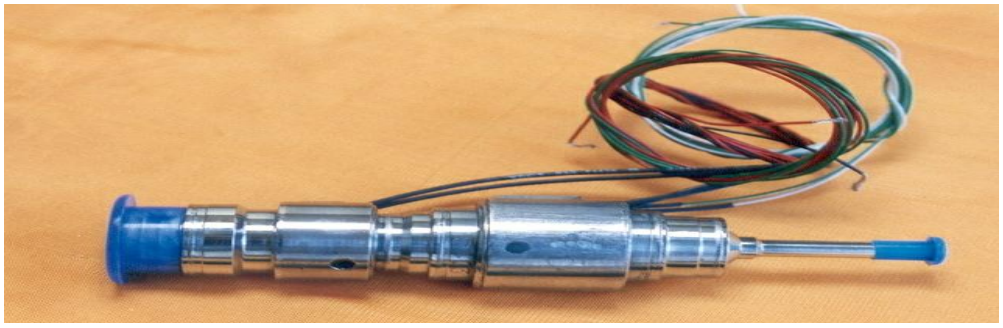
Fig.14 Latch Valve

VII. SOLENOID VALVE ASSEMBLY OPERATION (CHARASTIRISTICS)

Seal Carrier Body, Outlet Fitting & Flexures

Fig.15 Seal Carrier Body, Outlet Fitting & Flexures

IX.THE COMBINATION OF LOTCH VALVE AND SOLENOID VALVE



X. RESULTS AND CONCLUSION

As the manufacturing and assembly of the latch valve and solenoid valve together is called as LSRV. The main latch and solenoid valve are optimized from the pressure release existence. The lamp valve cannot maintain the pressure as the power supply is lost. So, to overcome that, the LSRV is used**.**

ACKNOWLEDGEMENT

The authors are grateful to the management of AVN Institute of Engineering and Technology, Department of Mechanical Engineering and also to the students K Aruna Jyothi, G Shirisha & D Kiran for their support- Koheda, R.R Dist., Telangana, India.

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