



DOCUMENT CODE: **PAS254-R-UK-U rev.00.00**

DATE: **04/04/2024**

DOCUMENT TYPE: **Guidelines**

APPLICABILITY: **Electronics UK**

SPECIAL PROCESSES GUIDEBOOK



SUMMARY / ABSTRACT:

When we refer to a 'Special Process' this is a reference to processes that are executed in Aerospace, Space & Defence production

The information contained in this document is proprietary to Leonardo UK Ltd. This document and the information contained herein may not be copied, reproduced, used or disclosed in whole or in part in any form without the prior written consent of Leonardo UK Ltd. The document is available on the Intranet / BMS. The validity of the copy, electronic or paper format, must be verified prior to use with the current version available on the Intranet / BMS.

Author[s]	Responsibility/ Unit	Name/ Signature
		Rab Meston

Owner	Project Assurance	
	Electronics UK	Tony Humphries

Authority	Project Assurance	
	Electronics UK	Andrew Walton

Amendment Summary

Rev.	Date	BMSCP No.	Change Summary	Author[s]
00.00	04/04/2024	CPN2222	Initial Issue.	Rab Meston

TABLE OF CONTENTS

1	INTRODUCTION	4
1.1	Purpose	4
1.2	Scope	4
2	WHAT DEFINES A SPECIAL PROCESS	4
2.1	ISO9000 & ISO9001 Definitions	4
2.2	AS9100 Requirements.....	4
2.3	Summary	5
3	PROCESS VALIDATION	5
3.1	Verifiable Processes (Non-special Process).....	5
4	SPECIAL PROCESS VALIDATION	5
4.1	Process Control	5
5	RISKS.....	6
6	STANDARDS & SPECIFICATIONS	6
7	SPECIAL PROCESS COMMODITIES	7
8	PERFORMANCE REVIEW INSTITUE (PRI)	7
8.1	Nadcap	7
8.2	EAN 8	
9	IPC	8
10	RELATED DOCUMENTATION AND TOOLS	8
10.1	Documents	8
10.2	Resources	8

1 INTRODUCTION

1.1 Purpose

This purpose of this document is to increase knowledge and understanding of Special Processes.

1.2 Scope

When we refer to a 'Special Process' this is a reference to processes that are executed in Aerospace, Space & Defence production.

Special Processes are identified by the Leonardo Engineering Organisation and referenced on assembly or part drawings and specifications (i.e. specified finishes for surface treatments, soldering, etc.).

2 WHAT DEFINES A SPECIAL PROCESS

2.1 ISO9000 & ISO9001 Definitions

ISO9000 section: 3.4.1 Process, Note 5: "A process where the conformity of the resulting output cannot be readily or economically validated is frequently referred to as a '**Special Process**'"

ISO9001 section: 8.5.1 f) - "The validation, and periodic revalidation, of the ability to achieve planned results of the processes for production and service provision, where the resulting output cannot be verified by subsequent monitoring or measurement."

2.2 AS9100 Requirements

AS9100 section 8.5.1.2 Validation and Control of Special Processes; for processes where the resulting output cannot be verified by subsequent monitoring or measurement, the organization shall establish arrangements for these processes including, as applicable:

- a) definition of criteria for the review and approval of the processes;
- b) determination of conditions to maintain the approval;
- c) approval of facilities and equipment;
- d) qualification of persons;
- e) use of specific methods and procedures for implementation and monitoring the processes;
- f) requirements for documented information to be retained.

Special Process – Leonardo UK (LEUK) defines a special process as a method controlled by specification where:

- The product undergoes a physical, chemical or metallurgical transformation or special examination, where conformance to the specification cannot be readily verified by normal inspection methods, and
- The quality of the product depends on use of specific equipment operated in a specific manner, under controlled conditions, by trained personnel with instructions, procedures and standards.
- Special Process Examples may include but are not limited to Welding, brazing, heat treating, inorganic finishing, non-destructive testing, impregnation of castings, metal spray, painting, soldering, radiography, dye penetrant inspection, plating, etc.

2.3 Summary

A special process is when the output of a process cannot be verified without destruction of the product. Generally, if you cannot measure or confirm the output of a process (the resulting product or service) with calibrated tools or instruments and know whether it conforms to specifications, the process is likely a special process that requires validation.

3 PROCESS VALIDATION

3.1 Verifiable Processes (Non-special Process)

For any Non-Special Process, the output of the process is verifiable through various testing methods, usually conducted during production verification or inspection.

For example, measuring the diameter of a machined part that has been manufactured to design specifications, determined by LEUK. After a material has gone through the machine milling/turning processes, we can verify the manufacturer's compliance relative to the requested dimensions. This is done by the use of calibrated measuring tools. This verification can be called either the First Article Inspection or the product output inspection. These methods verify the production process.

4 SPECIAL PROCESS VALIDATION

4.1 Process Control

Special Processes cannot be easily verified and validated to ensure process control.

When compared to a non-special process, a different method is required to validate the process.

For Special Processes, it is the process itself that must be verified and validated. This is usually conducted by performing audits or periodic testing of key process parameters, Operators will perform the process in accordance with the required process specification.

Special Processes are controlled by a defined set of characteristics / parameters that are documented and controlled throughout the manufacturing processes to ensure repeatability

The following are methods to validate special processes:

- Validation of the process parameters / Process Control Plan
- Periodic destructive testing of sample test pieces, processed under manufacturing conditions.
- Qualified operators are audited or re-qualified over set periods.
- Monitoring, testing and system accuracy is also tested. We monitor the process, equipment and measurement instrumentation.

The processes are periodically re-assessed for re-validation to ensure continuous control.

Usually validation consists of processing a test piece or test standard made of the same material with known properties through the special process and then destructively testing the test piece. For example for surface treatment such as chemical conversion coating, electroplating, anodising or application of paint, the validation includes the periodic adhesion testing and salt spray (corrosion) testing of test coupons that are processed on a monthly or batch basis etc.

There are certain Special Processes that require staff/operators to be qualified to a set standard to be allowed to execute the required process. For example, personnel working in non-destructive testing must be certified to NAS410, with a level 2 and level 3 required on site. This does not negate the need to validate the process.

5 RISKS

If special processes are not validated or periodically tested (re-validated) then, as a consequence, deficiencies can become apparent only after the product is in use or the service has been delivered. For example where parts are coated (plated or painted), lack of process control can result in poor adhesion and the coating may crack, blister, flake or peel after delivery or in service etc.

The risk is minimised if we ensure the correct process, operator and materials are used when conducting special processes. If the process is followed to the same method as how it has been previously validated, risk is reduced to a minimum.

6 STANDARDS & SPECIFICATIONS

All special processes have a related standard or specification that defines the validation method, frequency and criteria to be applied. For example AMS2750 for heat treatment or MIL-DTL-5541 for chemical conversion coatings etc.

For Special Processes Leonardo requires:

- Process Qualification / Certification;
- Process Specification.

In addition, when a special process is referenced in the applicable drawing/technical documentation, the following requirements shall be met:

- Definition of the special processes,
- Identification of the characteristics to ensure its repeatability under controlled conditions.
- Description of the types of control to ensure the output meets specification.


Special processes, shall be validated and periodically reviewed to ensure output meets required specification and process is to the required standard.

If we were requesting a supplier to conduct the special process of Chemical Conversion Coating (No Hexavalent Chromium), the requirement for this process will be specified on manufacturing drawings as follows:

Chemical Conversion Coating (No Hexavalent Chromium) in accordance with AP50104299

The manufacturing requirements we request will also be specified in this pack we provide to the supplier. It will detail any necessary elements to the production process, as well as detail the test requirements and the frequency of testing we will conduct.

Here are some example drawing notes:

- 1. THIS ASSEMBLY SHALL BE MANUFACTURED IN ACCORDANCE WITH IPC-J-STD 001 CLASS 3.
- 5. PENETRANT FLAW DETECTION (PFD) IN ACCORDANCE WITH MIL-STD-1907.
- 9. FINISH :- AFTER CLEANING AND PRIOR TO PAINTING, CHEMICAL CONVERSION COATING (CHROMATE) IN ACCORDANCE WITH, AP50057019 GRADE 1.
TEST REQUIREMENTS:- SEALING SURFACE.
- △ 10. MASK ALL HOLES, FEATURES SHOWN HATCHED/CROSSHATCHED AND ALL INTERNAL FEATURES PRIOR TO PAINTING AS FOLLOWS (SEE SHEET 4) :
PAINT ALL UNMASKED SURFACES USING 1 COAT PRIMER AS PER MIL-PRF-23377 TYPE 11 CLASS N2 FOLLOWED BY 2 COATS OF TOP COAT AS PER MIL-DTL-64159, COLOUR SCHEME IN ACCORDANCE WITH FED-STD-595B, COLOUR No. 34031 AIRCRAFT GREEN. WHERE APPLICABLE, DIMENSIONS APPLY AFTER PAINTING.
- △ 11. SURFACES MARKED  TO BE ELECTROLESS NICKEL PLATED IN ACCORDANCE WITH AMS2404 CLASS 1, AMS-C-26074 GRADE A. PHOSPHORUS CONTENT OF THE PLATING TO BE 7 TO 9% BY WEIGHT. BASE MATERIAL SURFACE FINISH TO BE 0.4 MICRONS. DIMENSIONS APPLY AFTER PLATING.

7 SPECIAL PROCESS COMMODITIES

Additive Manufacturing	Chemical Processing	Composites
Laser & Electron Beam Metallic Powder Bed	Electroplating, Electroless Plating, Anodising, Chemical Conversion Coatings, Passivation, Painting & Dry-Film, Etching & Chemical Cleaning	Prepreg, Adhesive Bonding, Resin Film Infusion (RFI), Metal Bonding, Core Processing, Liquid Resin Processing
Electronics	Heat Treating	Metallic Materials Manufacturing
Printed Circuit Board (PCB) Manufacture, PCB Assembly (inc. soldering), Cable and Harness Assemblies, Conformal Coating	Brazing, Aluminium Heat Treating, Carburizing, Gas/Ion/Plasma Nitriding, Hot Isostatic Pressing, Induction Hardening, Sintering	Forging, Casting, Metallic Powder Manufacture
Non-Destructive Testing	Non Metallic Materials Manufacturing	Welding
Penetrant Flaw Detect, Anodise Flaw Detect, Magnetic Particle Inspection, Ultrasonic Testing, Radiographic Inspection Testing, Eddy Current Inspection Testing	Adhesive Films, Fibres, Prepreg, Resin, Core	Fusion Welding & Evaluation of Welds, Rotational Friction/Inertia Welding, Torch/Induction Brazing, Flash Welding & Laser Welding, Electron Beam Welding, Resistance Welding

8 PERFORMANCE REVIEW INSTITUTE (PRI)

PRI (Performance Review Institute) is a non-for-profit organisation that have offices in USA, UK, China and Japan.

it provides supply chain oversight programs, quality management systems approvals and professional development.

PRI controls the Nadcap program

8.1 Nadcap

Nadcap is an industry-managed approach to conformity assessment that brings together technical experts from both Industry and Government to establish requirements for accreditation, accredit Suppliers and define operational program requirements.

Nadcap assessments are process-specific and very detailed. They are far more stringent than quality system audits such as AS9100. Nadcap process accreditation is a mandatory requirement for suppliers to Lockheed, Northrop Grumman, SAAB, Raytheon, Navair and others

8.2 EAN

EAN (formally EAuditNet) is web-based software that supports and improves efficiency in the auditing and accreditation systems of industry-managed programs administered by the Performance Review Institute. EAN is developed and maintained by PRI for the benefit of industries where safety and quality are shared values, implementing a standardized approach to quality assurance.

9 IPC

IPC (Institute for Interconnecting and Packaging Electronic Circuits) is a global non-profit, member-driven organization and leading source for industry standards, training, industry intelligence and public policy advocacy.

IPC members represent all facets of the electronics industry, including design, printed board manufacturing, electronics assembly, and test.

IPC is used in conjunction with PRI.

Note: IPC certification is applicable to an employee, the IPC checklist verifies the infrastructure to enable employee's to repeatedly meet the IPC requirements. The IPC Supplier statistics defines how many employees are IPC certified and should only be used as reference and not be used as a means to approve that supplier.

10 RELATED DOCUMENTATION AND TOOLS

10.1 Documents

Doc Code	Title
SAE AS9100C	Quality Management Systems - Aerospace - requirements
Nadcap AC7000 Series	Nadcap Audit Criterion for all Special Processes
IPC Series of Documents	The Global Association for Electronics manufacturing

10.2 Resources

Doc Code	Title
Leonardo Special Process Site	https://uk.leonardo.com/en/suppliers/special-processes
EAN Database	https://www.eauditnet.com/eauditnet/ean/user/login.htm
PRI Web page	https://p-r-i.org/nadcap/
IPC Website	https://www.ipc.org