

PROCEDIMIENTO PARA LA FABRICACIÓN DE PARTES PLÁSTICAS
TERMOFORMADAS PARA AVIACION, POR PERSONAL TÉCNICO EN
UNA ORGANIZACIÓN DE MANTENIMIENTO, EASA PART-145

Memoria del Trabajo Final de
Máster Universitario en Gestión
Aeronáutica
realizado por
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HOJA DE RESUMEN - TRABAJO FIN DE MÁSTER GESTIÓN AERONÁUTICA

Título del proyecto:	Procedimiento para la fabricación de partes plásticas termoformadas para aviación, por personal técnico en una organización de mantenimiento EASA Part-145	
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English:	EASA, Part-145, Maintenance organization, Local parts manufacturing	
Resumen: El presente documento consiste en presentar un procedimiento técnico que les permita a las organizaciones de mantenimiento Part-145, aplicar ante la Agencia Europea de Seguridad Aérea (EASA) para obtener la aprobación de fabricar localmente piezas plásticas termoformadas utilizadas en la cabina de pasajeros, tales como; <i>Tray Tables, Shrouds, Armcap, Covers, etc.</i> Partes cosméticas que en caso de falla no afectaran la seguridad del vuelo y el aterrizaje de la aeronave. Con esta capacidad aprobada se logrará reducir significativamente los costos de mantenimiento de las aeronaves y se podrá mejorar los tiempos de reparación por disponibilidad en repuestos, todo esto basados en las regulaciones aeronáuticas y prácticas de la industria aplicables. Resum: El present document consisteix en presentar un procediment tècnic que permet a les organitzacions de manteniment Part-145, aplicar a l'Agència Europea de Seguretat Aèria (EASA) per obtenir l'aprovació per a la fabricació local de peces plàstiques termoformades utilitzades a la cabina de passatgers, com ara; <i>Tray Tables, Shrouds, Armcap, Covers, etc.</i>, peces cosmètiques que en cas de falla no afectessin la seguretat de el vol i l'aterratge de l'aeronau. amb aquesta capacitat aprovada s'aconseguirà reduir significativament els costos de manteniment de les aeronaus i es podrà millorar els temps de reparació per disponibilitat en recanvis, tot això basats en les regulacions aeronàutiques i pràctiques de la indústria aplicables. Abstract: This document consists of presenting a technical procedure that allows maintenance organizations Part-145 to apply to European Union Aviation Safety Agency (EASA) to obtain approval to locally manufacturing thermoformed plastic parts used in the passenger cabin, such as; <i>Tray Tables, Shrouds, Armcap, Covers, etc.</i>, Cosmetic parts that in case of failure will not affect continued safe flight and landing of the aircraft. With this approved capability, it will be possible to significantly reduce aircraft maintenance costs and improve repair times due to availability of spare parts and based upon applicable regulations aeronautical and practices industry.		

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Capítulo 1. Introducción

El siguiente trabajo de fin de máster consiste en la elaboración de un procedimiento técnico aceptable que describa las normas regulatorias, la organización, y los procedimientos que debe seguir una organización de mantenimiento EASA Part-145, para obtener la capacidad de fabricar localmente partes plásticas termoformadas para aviación de categoría cosmética producidas por parte de su personal de mantenimiento de acuerdo con los medios de cumplimiento aceptables de EASA (**AMC1 145.A.42(b)(iii), Components; FABRICATION OF PARTS FOR INSTALLATION**), tales partes serán utilizadas e instaladas por la organización en el transcurso de la revisión, mantenimiento, modificación o reparación de aeronaves o sus componentes, trabajos que serán realizados en sus propias instalaciones [1].

Se hace uso del procedimiento propuesto como herramienta valiosa para el apoyo del mantenimiento el cual está desarrollado bajo guías regulatorias de EASA, [1], [2], [3], y de la misma manera soportado técnicamente con especificaciones dadas por los fabricantes [4], [5], [6], datos aceptables que definen y establecen los requerimientos de ingeniería para desarrollar el proceso de termoformado de láminas termoplásticas, procesos que garantizan la trazabilidad de cada parte fabricada por la organización de mantenimiento.

Hoy por hoy las organizaciones de mantenimiento aeronáutico buscan estrategias para optimizar sus costes operativos, las industrias involucradas en los procesos de mantenimiento aeronáutico apuntan hacia un hecho ineludible en los negocios que argumenta que la competencia gira en torno a las capacidades que pueden desarrollar y ofrecer a sus clientes, por esta razón las empresas para generar ingresos adicionales o lograr reducir sus costes operativos, necesitan adoptar e invertir en iniciativas orientadas estratégicamente que agreguen valor a los servicios ofrecidos a sus clientes y de esta manera ganar fidelización en el mercado.

Entre los muchos problemas a los que se enfrentan las organizaciones de mantenimiento está el de la no disponibilidad y entrega oportuna de repuestos por parte de los proveedores, esto generalmente causa retrasos y sobrecostos, ya que si no se cuenta con las piezas de repuesto no se podrá continuar con los procesos de reparación en los tiempos establecidos. No obstante, la integración efectiva de la función de mantenimiento con la reingeniería en funciones de fabricación de partes para la reparación de aeronaves y sus componentes puede ayudar a ahorrar grandes cantidades de tiempo y dinero al tratar de solucionarlos localmente por las mismas organizaciones de mantenimiento en sus propias instalaciones.

Este proyecto busca responder a la pregunta: ¿puede una organización de mantenimiento EASA Part-145 implementar localmente un proceso de fabricación de partes plásticas producidas por su personal técnico y que este sea aprobado por las autoridades regulatorias?

1.1. Objetivos

El objetivo de este proyecto es construir un documento con los procedimientos regulatorios y técnicos que garanticen la trazabilidad de fabricar partes plásticas termoformadas para aviación por parte del personal técnico en una organización de mantenimiento EASA Part-145. Con base a esta iniciativa se comenzará por analizar las normativas aplicables técnicas y regulatorias para desarrollar procesos de fabricación aceptables por las autoridades aeronáuticas, para luego formular una propuesta de implementación capaz de relatar las ventajas y limitaciones que podrían tener las organizaciones de mantenimiento al incorporar procesos de fabricación de partes en las tareas de mantenimiento de aeronaves y componentes en sus propias instalaciones.

1.2. Origen y motivación

El motivo por el cual se realiza este trabajo de fin de máster es demostrar los conocimientos adquiridos en las diferentes materias impartidas durante el desarrollo de la maestría, adicionalmente mi experiencia como ingeniero aeronáutico me permitió identificar oportunidades que pueden dar valor agregado a las tareas de mantenimiento. En este proyecto pretendo transmitir una propuesta que desarrollada por las organizaciones de mantenimiento EASA Part-145 le permitirán obtener la aprobación por parte de la autoridad competente para implementar procesos de fabricación de partes plásticas termoformadas en sus propias instalaciones, con esta capacidad se optimizan los procesos de reparación de aeronaves y sus componentes.

Si la propuesta llegara a tener eco en los gestores responsables de las organizaciones de mantenimiento, me sentiría profundamente agradecido y estaría disponible a soportarlos en el desarrollarlo de la implementación y ejecución del proyecto.

Todos (o la gran mayoría) de documentos que hablan sobre el tema del presente proyecto están redactados en idioma inglés, al igual que las regulaciones de EASA, motivo por el cual y para mantener el estándar lingüístico el procedimiento técnico se desarrolla en su totalidad en esta lengua.

1.3. Contenido de la memoria

La estructura del presente documento se ha pensado de manera que sea de fácil seguimiento en los distintos aspectos que van apareciendo durante su recorrido. Por este motivo, el trabajo consta de 4 capítulos (incluyendo el actual) y dos anexos donde se expone el procedimiento objeto de este proyecto, y la guía de orientación dada por EASA, se organizan de la siguiente manera:

- Capítulo 1: Introducción - Temática del trabajo de fin de máster; objetivos; origen y motivación para realizarlo; contenido de la memoria resumido por capítulos.
- Capítulo 2: Procedimiento – En este capítulo se explica la estructura del procedimiento, las referencias regulatorias y técnicas, utilizadas para su construcción, al igual que la guía detallada recomendada por EASA para demostrar ante la autoridad aeronáutica su aplicabilidad y cumplimiento.
- Capítulo 3: Propuesta de Implementación – Este capítulo se constituye como una guía para elaborar el caso de negocio. Dirigida especialmente a las organizaciones de mantenimiento EASA Part-145.
- Capítulo 4: Conclusiones – se expondrán las conclusiones que se hayan realizado al efectuar el presente trabajo, y también una evaluación del trabajo en temas de cumplimiento de los objetivos expuestos más arriba.
- Anexo A: En este anexo se expone el documento técnico “*Procedure Thermoforming of Thermoplastic Sheet Materials* (PTTSM)” que soporta la fabricación de productos plásticos termoformados producidos por una organización de mantenimiento EASA Part-145.
- Anexo B: Por último, en este anexo se presenta el documento guía # UG.CAO.00131-002 “*Foreign Part-145 approvals - Fabrication of Parts*”. Usado para construir la estructura del procedimiento [2].

Capítulo 2. Procedimiento

El procedimiento referenciado en el Anexo A “*Procedure Thermoforming of Thermoplastic Sheet Materials* (PTTSM)”, objeto y propósito de este proyecto, se construyó para que las organizaciones de mantenimiento aprobado EASA Part-145, que estén interesadas en fabricar partes plásticas termoformadas dentro de sus propias instalaciones, puedan formalizar su solicitud de aceptación ante la Agencia Europea de Seguridad Aérea (EASA).

La regulación de EASA Part-145, brinda la posibilidad para que las organizaciones de mantenimiento tengan la autorización para fabricar una gama restringida de piezas que se utilizarán en el curso del mantenimiento dentro de sus propias instalaciones. El término "fabricación" se utiliza en el entorno de la EASA Part-145 para identificar una producción restringida de partes bajo las limitaciones de la AMC1 145.A.42 (b) (iii) [1], [3].

Este procedimiento permite asegurar que las partes plásticas termoformadas fabricadas durante las tareas de mantenimiento tengan un nivel equivalente de seguridad como lo tienen las piezas producidas bajo el certificado de producción del titular del diseño original, sin embargo este procedimiento solo está destinado a cubrir la fabricación de piezas plásticas termoformadas por parte de las organizaciones de mantenimiento y no se puede utilizar de ninguna manera para respaldar la fabricación de piezas según las regulaciones de la Parte 21 de EASA.

El procedimiento “PTTSM”, tiene como propósito dar un direccionamiento a las organizaciones de mantenimiento EASA Part-145 brindando métodos aceptables que cumplen con los requisitos regulatorios para fabricar productos termoformados que se instalarán en el transcurso de las tareas de mantenimiento y reparación de aeronaves y sus componentes. El alcance incluye: Responsabilidades en gestión de normas y políticas regulatorias, descripción y clasificación de los productos a fabricar, referencias de facilidades equipos y herramientas utilizadas en el proceso de fabricación, procedimientos de inspección de calidad, control de materiales, requerimientos de entrenamiento del personal, aprobación y aceptación de productos, marcado de las partes, control de productos no conformes, procedimientos de ingeniería y demás información pertinente.

El procedimiento técnicamente está definido por los requerimientos de ingeniería para el termoformado de materiales termoplásticos referenciados en los procedimientos: “*Airbus Process Specification AIPS 03-02-008*”, “*Instruction Process Specification IPS 03-02-008*” y los “*Process and Material Specifications PMS 02-12-03 - PMS 02-12-07 - PMS 02-12-10*” [4],[5],[6].

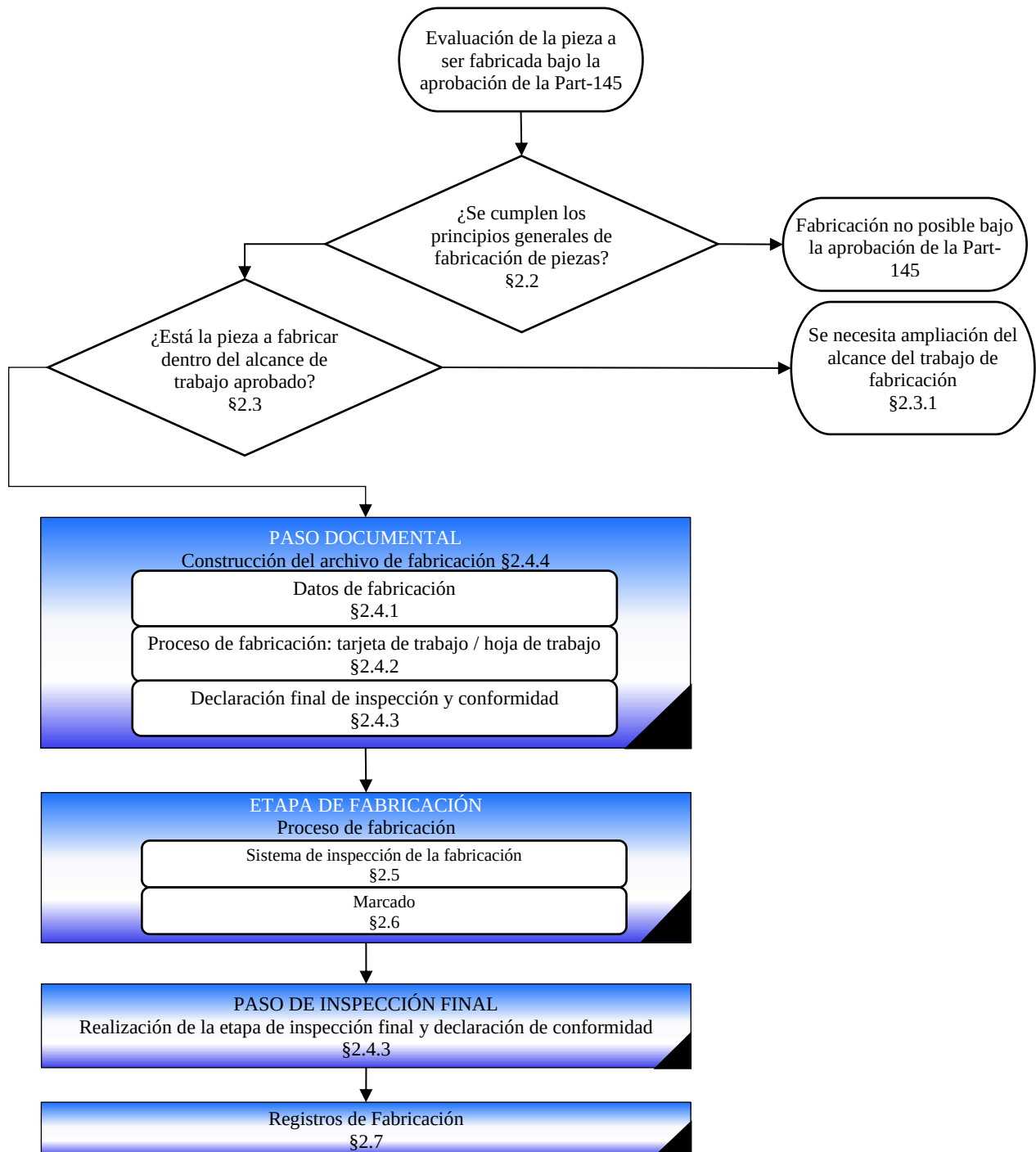
El procedimiento “PTTSM”, está diseñado para dar cumplimiento a los requerimientos regulatorios dados por la EASA para la aprobación de la fabricación de partes los cuales están limitados en la guía # **UG.CAO.00131-002** [2] (véase anexo B), con fecha de aprobación vigente del 28/02/2019, aplicable a los solicitantes de EASA Part-145 y a las AMO part-145 de EASA (referenciadas como organizaciones de mantenimiento) que tengan su sede comercial principal fuera de los Estados miembros de la UE y que no estén certificadas según las disposiciones de un acuerdo bilateral firmado con la UE, esta guía orientativa permite a las organizaciones de mantenimiento tener como referente los lineamientos para formalizar la solicitud de aceptación ante la autoridad competente para fabricar piezas bajo la aprobación de la EASA part-145.

La información contenida en el procedimiento “PTTSM”, está estructurada de tal manera que permite dar seguimiento a los requerimientos establecidos en el diagrama de flujo descrito en la guía # UG.CAO.00131-002 de EASA, parágrafo 1.1 [2] (véase anexo B), a continuación, se permite reconocer la secuencia de procesos de la guía y su interacción con los procesos del procedimiento “PTTSM”

- Evaluación preliminar, En este bloque se determina si la parte a fabricar reúne los principios generales sujetos a la aprobación de la EASA Part-145.
- Paso documental, En este apartado se establece la construcción del archivo de fabricación en el que se encuentran los datos de la parte, el proceso de fabricación, la declaración final de inspección y de conformidad, información que le permitirá a la organización de mantenimiento demostrar ante EASA que cumple con los datos mínimos exigidos para soportar la trazabilidad de las partes a fabricar.
- Etapas de fabricación, donde se referencia el sistema de inspección para la fabricación y el marcado de las partes
- Etapas de inspección final y declaración de conformidad
- Récord de Fabricación, evidencia documental de registros de soporte satisfactoriamente completados.

2.1. Diagrama de flujo del proceso

Tomado de la guía # UG.CAO.00131-002 de EASA [2] (anexo B), los numerales fueron adaptados a este capítulo con el fin de lograr demostrar el cumplimiento con el procedimiento “PTTSM”



2.2. Principios generales para la fabricación de piezas

Al considerar la fabricación de piezas plásticas termoformadas bajo la aprobación EASA Part-145, los principios aplicados dentro del procedimiento deben ser claramente identificados por la organización de mantenimiento en el proceso de solicitud, tales principios comprenden:

- La organización de mantenimiento debe incluir en su manual del MOE, el permiso para fabricación de partes referenciado el procedimiento objeto de este proyecto el cual está incluido en el Anexo A “*Procedure Thermoforming of Thermoplastic Sheet Materials* (PTTSM)”, tal referencia en la solicitud se debe realizar en los numerales del manual de la organización de mantenimiento MOE 1.9 “alcance del trabajo”, párrafo 1.9.4.5, y de la misma manera establecido en el numeral MOE 2.9.2 “fabricación de partes”, esto debe ser acordado y aprobado por la autoridad competente [3].
- EASA solicitará a la organización de mantenimiento justificar la razón del porque la necesidad de fabricar una pieza o un lote de piezas, en lugar de realizar la adquisición normal de la pieza original. La justificación ante la autoridad sin duda debe ser dada en el contexto en los extensos tiempos de entrega por parte de los fabricantes originales, tiempos que pueden llegar a superar los 120 días para que se realice su despacho, sujeto a esto está la falta de disponibilidad de repuestos para realizar las tareas de mantenimiento, también es razón de justificación aplicable para las partes que ya no se consiguen directamente con los fabricantes originales por obsolescencia o discontinuidad de producción.
- La organización de mantenimiento deberá proporcionar pruebas ante EASA que le permitan asegurar que las partes plásticas a fabricar cuentan con los datos suficientes de información para soportar dicha fabricación, en tal caso la información que se debe presentar corresponde a los planos y a las especificaciones técnicas del material de construcción de las piezas, en este caso el procedimiento “PTTSM” del anexo A, en la Parte F “engineering process” establece dos métodos para determinar el proceso de ingeniería aplicable que le permitirá a la organización de mantenimiento recopilar esta información.
 - Datos técnicos suministrados por el fabricante original con autorización directa del titular de la aprobación de diseño para fabricar esas piezas específicas, en la que incluirá la identificación de los datos de fabricación (por ejemplo, dibujos, materiales, etc.).

- Método de ingeniería inversa, si no existe información disponible por obsolescencia o discontinuidad de producción por parte del fabricante original
- La fabricación debe realizarse durante el mantenimiento es decir que los artículos fabricados solo pueden instalarse en productos y / o componentes sometidos a mantenimiento en la misma organización de mantenimiento que fabrica las piezas;
 - De acuerdo con la parte E “Thermoforming Quality Control System” del procedimiento “PTTSM” en el numeral 11 “Termoformado de múltiples productos” se justifica la fabricación de una cantidad idéntica de partes de la misma referencia que pueden ser fabricadas a la vez que serán consumidas en reparaciones posteriores hechas por el personal de mantenimiento, limitado a no almacenarlas por largo plazo. Esto significa que solo se pueden almacenar por un tiempo limitado según lo justifique la duración del mantenimiento continuo para el que se han fabricado;
 - La fabricación de piezas se realizará dentro de las instalaciones de la organización de mantenimiento;
- Las piezas fabricadas bajo este procedimiento no califican para la certificación con el Formulario EASA form-1. Estas partes se deben fabricar con certificados de conformidad emitidos por la organización de mantenimiento, lo cual restringe el suministro y / o ventas posteriores a otras organizaciones.
- En razón y como se explica en la parte C, “Product Classification” del procedimiento “PTTSM” parágrafo 1 “clasificación de la parte”, los productos envueltos en el proceso de fabricación pertenecen a la categoría de partes no críticas es decir que no afectan la seguridad en las instrucciones de aeronavegabilidad continuada.

2.3. Alcance de fabricación de piezas

Como se mencionó anteriormente el solicitante, es decir la organización de mantenimiento debe detallar el alcance de la autorización para que se le permita hacer la fabricación de las piezas bajo la aprobación de la Part-145 de EASA, en este orden de ideas se debe referenciar en el contexto de la solicitud lo relacionado en el procedimiento “PTTSM”, ya que la fabricación debe estar claramente dentro de la capacidad técnica y de procedimiento de la organización de mantenimiento. La capacidad para fabricar piezas se definirá a través del contenido del manual MOE [3], en particular:

- El capítulo 1.9 del MOE “Alcance del trabajo”, deberá especificar si el permiso de fabricación de piezas está incluido o no es aplicable;

- Cuando se incluye el permiso, el capítulo 2.9 del MOE. “Procedimiento de reparación” describirá con más detalle el procedimiento de fabricación de piezas en el párrafo 2.9.2

2.3.1. Identificación de grupos de fabricación

El grupo de fabricación se identificará en el MOE 2.9 y se limitará a aquellos para los cuales la organización de mantenimiento obtuvo la aprobación es decir fabricación de partes plásticas termoformadas demostrando a la autoridad competente que tiene la capacidad técnica efectiva para realizar estos trabajos.

2.4. Archivo de fabricación

2.4.1. Datos de fabricación

El procedimiento para la fabricación de partes plásticas termoformadas “PTTSM”, del anexo A, se construyó técnicamente utilizando las especificaciones dadas por el fabricante Airbus en los documentos: “*Airbus Process Specification AIPS 03-02-008*”, “*Instruction Process Specification IPS 03-02-008*” y para los materiales el “*Process and Material Specifications*”, “*PMS 02-12-03 - PMS 02-12-07 - PMS 02-12-10*” [4] [5] [6].

Los datos en planos con los números de parte, dimensiones, tolerancias, materiales y serán completados como lo establece el procedimiento “PTTSM”, en la Parte F “engineering process” de acuerdo con el método aplicable.

2.4.2. Proceso de fabricación: tarjeta de trabajo / sistema de hoja de trabajo.

Tal como está establecido en el procedimiento “PTTSM”, en la parte E, “Thermoforming Quality Control System” párrafo 6 “proceso de termoformado” La organización de mantenimiento a través de su control calidad debe seguir y verificar los pasos dados en el formato “THERM-04” para garantizar que en el progreso de la fabricación de la parte se cumplió con el paso a paso dado en el procedimiento y de esta manera asegurarse de mantener una trazabilidad de dichas instrucciones para cada pieza fabricada individualmente.

Adicionalmente la organización de mantenimiento a través del formato “THERM-03” del procedimiento “PTTSM”, asegura que cada pieza está vinculada para su uso en un producto o componente específico que se somete a mantenimiento dentro de la organización, por esta razón el formato permite demostrar la disposición final de instalación del producto fabricado.

Los datos que soportan la fabricación, tales como, herramientas requeridas, la numeración de piezas, las dimensiones con tolerancias, el requisito de inspección, la especificación de la materia prima, los procesos de fabricación detallados, técnicas de fabricación, instrucciones de marcado, inspecciones intermedias y finales, ensayos, etc. están contenidos en el formato “THERM-04” y los planos de cada parte a fabricar.

2.4.3. Declaración final de inspección y conformidad

El procedimiento “PTTSM”, en la parte E, “Thermoforming Quality Control System” parágrafo 7 “aceptación de productos termoformados”, establece los criterios que debe seguir la persona de control calidad para aceptar que la pieza fabricada esta conforme a los requerimientos exigidos en el procedimiento, de la misma manera se exige que haya evidencia de esta inspección la cual es documentada en el diligenciamiento del formato “THERM-04” en el apartado 2.8 “approval inspection”

2.4.4. Composición del archivo de fabricación

En conclusión, para respaldar y registrar el proceso de fabricación de las piezas, se utilizará un "archivo de fabricación" estándar para cada pieza o lote a fabricar por la organización de mantenimiento, compuesto por:

- a) Planos de la parte a fabricar en incluyan (dimensiones, tolerancias y la especificación de la materia prima
- b) Formato THERM-04 con el proceso y etapas de fabricación - sistema de tarjeta de trabajo / hoja de trabajo” y declaración final de inspección y conformidad”
- c) Formato THERM-03 para el control en la disposición final de instalación de las partes fabricadas

Este “archivo de fabricación” constituirá los registros de mantenimiento especificados en el numeral 3.3 de este documento.

2.5. Sistema de inspección de fabricación – control calidad

El procedimiento “PTTSM”, en la parte E, “Thermoforming Quality Control System” proporciona información y orientación sobre los aspectos específicos del Sistema de Calidad para productos termoformados. El Sistema de Calidad establece e implementa un plan que verifica los parámetros que afectan la integridad del producto y que operan bajo condiciones controladas, los artículos individuales, o lotes de productos cumplen con los estándares de calidad entre los que están;

- a) Control de materiales
- b) Aprobación de productos a ser fabricados bajo este procedimiento
- c) Manipulación y almacenaje de materiales y productos
- d) Requerimientos de entrenamiento para el personal que ejecuta las tareas de fabricación
- e) Proceso de termoformado, el cual esta detallado paso a paso en el formato “THERM-04”
- f) Aceptación de los productos fabricados (criterios de inspección)
- g) Control de registros
- h) Marcado de los productos fabricados
- i) Control de productos no conformes
- j) Fabricación múltiple de productos
- k) Seguimiento de auditorías de calidad

2.6. Marcado

El proceso de marcado se realizará basados en la parte E del procedimiento “PTTSM”, referenciado en el párrafo 9 “marcado de productos termoformados”, donde se establecen dos métodos aceptables; uno es por sistema laser con equipos especializados dedicados para esta técnica y el otro es un método alternativo con tinta permanente de lapicero tipo sharpie,

2.6.1. Identificación del número de pieza de fabricación

Todas y cada una de las piezas fabricadas se marcarán de acuerdo con las instrucciones proporcionadas en el procedimiento “PTTSM”, en el formato “FORM-01”, con el propósito de estandarización y trazabilidad de piezas fabricadas por la organización de mantenimiento, la información que incluye es;

- Descripción y numero de parte de la pieza fabricada con el sufijo EPA que describe que es una pieza no original,
- Número de parte del fabricante original con el propósito de conocer el origen de la parte,
- la identidad de la organización de mantenimiento, numero de certificado de la OMA, EASA Part-145.
- información detallada de trazabilidad como lo es; fecha y lote de fabricación

2.7. Registros de fabricación

Los registros de fabricación constituyen evidencia objetiva de que:

- todas las etapas prescritas del proceso de fabricación se han completado satisfactoriamente;
- se ha logrado el cumplimiento de los datos aprobados para la fabricación;
- se garantiza la trazabilidad desde la pieza hasta los datos aprobados.

Por lo tanto, en el procedimiento en la parte E, párrafo 8 “registros” establece que la organización de mantenimiento se debe asegurar que cada producto termoformado tiene sus registros asociados que permiten demostrar el cumplimiento de los requisitos técnicos y regulatorios. Los registros que deben adjuntarse a cada producto fabricado son:

- Planos dimensionales de las piezas
- Formulario de procedimiento de termoformado “THERM-04”
- Formulario de control de instalación “THERM-03”
- Formulario de control de productos no conformes “THERM-02”

2.7.1. Registro de archivo de fabricación

El “archivo de fabricación” debe mantenerse para cada parte o lote de acuerdo con el tiempo de retención de registros provisto en EASA Part-145.A.55(c). Es responsabilidad de la organización de mantenimiento y está establecido en el procedimiento que los registros de fabricación de los productos termoformados deben custodiarse y conservarse durante un período de dos (2) años en el área de registros técnicos.

2.7.2. Lista de piezas fabricadas

Se establece en el procedimiento “PTTSM”, en la parte E párrafo 3 “productos aprobados” que la organización de mantenimiento mantendrá un listado actualizado de todas las piezas autorizadas para fabricar las cuales serán registradas en el formato “THERM-05” donde se garantice que todas las partes cuentan con los datos aceptables para ser fabricados posteriormente.

Por otro lado, con el formato “THERM-03” le permita a la organización de mantenimiento identificar las partes / lotes que han sido fabricados junto con la información del producto / componente en el que se han instalado esas piezas.

Capítulo 3. Propuesta de implementación

Este capítulo se constituye como guía para elaborar el caso de negocio “BC”. Se dirige especialmente a las organizaciones de mantenimiento EASA Part-145, específicamente para las áreas de ingeniería y sus talleres.

De ninguna manera pretende ser un modelo, por el contrario, por su descripción, se constituye en un instrumento de referencia que explica las pautas generales para organizar y estructurar la propuesta de caso de negocio. No obstante, podrá ser utilizada para evaluar la decisión de incorporar el proceso de fabricación de partes utilizando este procedimiento técnico, como una capacidad adicional a sus procesos de mantenimiento y de esta manera ser más competitivos en términos de reparación de aeronaves y sus componentes.

En primer lugar, es importante identificar las partes de la aeronave que pueden ser susceptibles a ser fabricadas por la estación de mantenimiento, una de las herramientas con las que cuentan las aerolíneas u operadores de las aeronaves son las estadísticas de reportes que hacen parte del programa NEF (Nonessential Equipment and Furnishings), con el cual se puede construir un listado de piezas que tengan un alto consumo en la operación y los tiempos de entrega por parte de los fabricantes superen los 30 días de “lead time”.

Los NEF son aquellos elementos instalados en la aeronave como parte de la certificación de tipo original, certificado de tipo suplementario u otra forma de alteración que no tiene ningún efecto en la operación segura del vuelo y no es requerido por las reglas de certificación o reglas de operación aplicables. Sin embargo, su no funcionabilidad tiene un gran impacto en el servicio y confort al pasajero.

Estos artículos no esenciales pueden estar instalados en áreas que incluyen, entre otras, el compartimiento de pasajeros, el área de la cabina de vuelo, las áreas de servicio, las áreas de carga, las áreas de descanso de la tripulación, los baños y las áreas de cocina.

Los artículos NEF se registran, rastrean y rotulan de acuerdo con los procedimientos especificados en la Lista de equipo mínimo MEL (Minimum Equipment List).

A continuación, se describen de acuerdo con su ubicación en la aeronave las partes vinculadas al programa NEF que posteriormente podrían ser parte del análisis para incluirlas en la lista de unidades a fabricar.

Lista de Artículos NEF

Passenger Cabin /Cabina Pasajeros

- *Appearance Items (including sidewall panels; excluding sidewall return air grills)*
- *Door Cover/Slide Bristle*
- *Coat Hanger*
- *Magazine Rack/Restraint*
- *PSU Panel*
- *Cabin Windows (interior cosmetic panel, interior panel, shades, and window trim)*
- *Literature Pockets (seatback, bulkhead, sidewall)*
- *Aircraft Removable Equipment (dry linen storage, waste containers)*

Galley / Cocinas

- *Waste Containers*
- *Air Gaspers*
- *Worktables*

Crew Cabin / Cabina de Tripulación

- *Coat and/or Hat Hooks*
- *Circuit Breaker Guards*
- *Cup Holders*
- *Document Holder*

Lavatories / Baños

- *Door Spring(s)*
- *Sanitizer Dispenser*
- *Toilet Seat Cover Holder*
- *Toilet Paper Holder*
- *Deodorizer Holder*
- *Interior Wall Trim and/or Coverings*
- *Air Grill Cover*

Passenger Seats / Sillas Pasajeros

- *Tray Table*
- *IAT Food Table*
- *Footrest(s) covers*
- *Plastic Covers*
- *Spreader Covers*
- *Cup Holder*
- *Video Shroud*

Se recomienda seleccionar para el caso de negocio inicialmente cinco números de parte, las cuales se pueden ir incrementando mensualmente de acuerdo con los requerimientos internos de la organización de mantenimiento.

3.1. Datos caso práctico – construcción caso de negocio (BC)

Nota. Los costes de equipos, materiales y adecuaciones físicas son de referencia al año vigente de 2020.

Estructura del Proyecto

Nombre del proyecto; Implementación del procedimiento para fabricación de partes plásticas termoformadas para aviación, “*Procedure Thermoforming of Thermoplastic Sheet Materials*, PTTSM”, por personal técnico en la organización de mantenimiento EASA part-145

Supuestos Iniciales:

Se escogen cinco números de parte identificados por su alto consumo en tareas de mantenimiento.

- Se recomienda realizar el BC en un periodo no superior a 5 años.
- La depreciación y vida útil de los equipos es de 10 años.
- IPC en USA 3% / IPC España 2.2%.
- Tasa de descuento para VPN 10%.

Evaluación por realizar:

Compra directa – escenario actual de donde se obtienen los datos de costes de compra para las unidades que hacen parte de esta evaluación, estos costes son dados por el fabricante para cubrir la demanda de partes utilizadas en mantenimiento.

Fabricación Local – segundo escenario, análisis de la inversión, este documento sugiere costes estimados en términos de tener un análisis cercano para la implementación del procedimiento los cuales pueden llegar a comprender; compra de equipos y herramientas, adecuación de facilidades e instalaciones de infraestructura, entrenamiento del personal que participa en el proceso de fabricación, compra de la materia prima.

Necesidad y periodo del proyecto:

- 1er año: 6 meses iniciales (3 meses adecuación de instalaciones y 3 meses para instalación y puesta en marcha de equipos), inicio de operaciones segundo semestre del año 1.
- 2do año: compra de materiales de consumo
- 3er año: compra de materiales de consumo y mantenimiento de equipos
- 4to año: compra de materiales de consumo y mantenimiento equipos.
- 5to año: compra de materiales de consumo y mantenimiento equipos

Costos de referencia para equipos y materiales:

Nº	Descripción	Coste Aprox.
1	Maquina principal (Termoformado) - Ref.: C54S	118.000 €
2	Equipo de corte CNC - Ref. Trim 4015	150.000 €
3	Equipo de marcado laser - Ref.: RMI EF-20	32.000 €
4	Horno de secado para plásticos - Ref.: CD-20	4.200 €
5	Equipo medición de temperatura - Ref.: Fluke 568	400 €
6	Herramienta de corte: Consumo Fresas/Brocas	200 €
7	Materia prima laminas plásticas (300 láminas)	400 €
TOTAL		305.200 €

Inversión inicial:

Se estima un coste de referencia de **200,000 €** pagados una única vez del año 1, para adecuación de facilidades.

Se presupuestan **20.000 €** para entrenamiento del personal técnico.

Coste aproximado proyectado para implementación del proyecto

Nº	Descripción	Coste Aprox.
1	Coste de Equipos y materiales	305.200 €
2	Adecuación de facilidades	200.000 €
3	Entrenamiento técnico	20.000 €
TOTAL, PROYECTADO		525.200 €

Análisis interno - costes actuales a considerar:

La organización de mantenimiento interesada en implementar el procedimiento técnico deberá evaluar internamente las partes que desean fabricar localmente, identificando los siguientes datos para construir el caso de negocio:

Partes que su origen de fabricación sea por proceso de termoformado
 Piezas que hagan parte del programa NEF
 Cantidad de unidades consumidas en promedio por año
 Tiempos de entrega superiores a 30 días por parte de los proveedores
 Costes de las unidades.
 Coste logístico y de almacenamiento del inventario.

3.2. Ventajas de implementación

Contar con la capacidad de fabricar partes localmente dentro de la estación de mantenimiento permite entre cosas; optimización en los tiempos de respuesta, desde la etapa inicial del proceso de reingeniería hasta la fabricación e instalación de las partes en las aeronaves. De igual manera esta capacidad permite producir fácil y rápidamente unidades que sean requeridas para cumplir con las tareas de mantenimiento con cierta flexibilidad que conduce a una solución más rápida. Por tanto, ayuda a optimizar el coste y el tiempo de mantenimiento.

- **Reducción de costes**

La fabricación de piezas localmente permite reducir los costes de mantenimiento, ya que la misma producción por su simplicidad hace que el proceso sea bastante sencillo y solo en el coste de los materiales su reducción es de más del 98%, por ejemplo, una mesa para una silla de pasajeros de tipo turista puede alcanzar un coste promedio de **650 €**, mientras que la chapa plástica para fabricar esta misma mesa tiene un valor cercano de **16 €**, sumando costos directos e indirectos referentes a todo el proceso de fabricación, se logra una optimización de más del 90% por unidad fabricada.

Realizar procesos de autoabastecimiento de repuestos que para este caso son de tipo plástico termoformado es más rentable por la producción de lotes pequeños, la producción de bajo volumen permite flexibilidad y se apoya en el concepto del cero desperdicio.

En resumen, la producción de partes por termoformado localmente no solo proporciona una solución rápida y rentable, sino también una producción por lotes rentable para un volumen más pequeño de productos.

- **Soluciones y propuestas a través de materiales personalizados**

Las aerolíneas buscan innovadores diseños para ganar fidelización con sus clientes y algunas de ellas optan por realizar modernización a sus cabinas.

Existen amplias gamas de colores y texturas de materiales termoplásticos certificados para ser utilizados en procesos de manufactura aeronáutica, y por supuesto para ser transformados por procesos de termoformado, estos materiales son ideales y pueden ser utilizados para personalizar las cabinas si así lo requieren los clientes.

- **Reducción por costes logísticos**

Los costes en impuestos, importación, aduanas, etc. que conllevan la compra de partes aeronáuticas a menudo son bastante costosas, el autoabastecimiento de estas unidades dentro de las organizaciones de mantenimiento reduce significativamente los costes, a medida que esté disponibles los repuestos requeridos para el cumplimiento de las tareas de mantenimiento.

3.3. Restricciones / Limitaciones

- **Limitaciones de implementación**

Podría haber ciertas limitaciones que deben ser evaluadas y consideradas antes de intentar implementar este proceso dentro de la organización.

Principalmente para aplicar ante las autoridades regulatorias en la aprobación de este procedimiento se debe contar con:

- Manuales, documentos, especificaciones controladas y actualizadas que estén disponibles.
- Instalaciones y facilidades adecuadas para desempeñar la actividad.
- Equipos y herramientas con controles de calibración y programas de mantenimiento adecuado.
- Programa de entrenamiento, personal certificado y con las habilidades para desempeñar estas funciones.
- Materiales Aeronáuticos, con trazabilidad que permitan garantizar su origen y utilización en la fabricación de partes aeronáuticas.

NOTA: Dentro de las facilidades se debe disponer de mínimo un área de 150 mts² para la instalación de máquinas y puestos de trabajo. De igual forma se debe garantizar disponibilidad eléctrica superior a 250 KW para el funcionamiento de los equipos.

Capítulo 4. CONCLUSIONES

Como resultado de la elaboración del presente trabajo de fin de master, cabe mencionar que el objetivo propuesto de construir un documento con los procedimientos regulatorios y técnicos que garanticen la trazabilidad de fabricar partes plásticas termoformadas para aviación (véase anexo A), “*Procedure Thermoforming of Thermoplastic Sheet Materials (PTTSM)*”, por parte del personal técnico en una organización de mantenimiento EASA Part-145, se ha conseguido satisfactoriamente, lo que permitirá a las organizaciones interesadas poder aplicar ante EASA como solicitante para recibir la autorización de fabricar partes en sus instalaciones. Es importante aclarar que la autorización no constituye una aprobación como fabricante, o para suministrar o vender las partes a externos, las piezas no califican para la certificación EASA Form 1, su aprobación se limitara a piezas fabricadas y utilizadas en el curso de las tareas mantenimiento dentro de sus propias instalaciones.

Tras haber analizado cuidadosamente la guía orientativa # UG.CAO.00131-002 de EASA (véase anexo B), denominada “*Foreign Part-145 approvals - Fabrication of Parts*” fue posible estructurar el procedimiento “PTTSM” de tal manera, que se demostrara el cumplimiento a todas sus normativas, cuidando siempre que estos estén amparados bajo las reglamentaciones de EASA, es así como este procedimiento se constituye como una herramienta valiosa para que las organizaciones de mantenimiento puedan seguir sus instrucciones y den cumplimiento a lo allí escrito, adicionalmente su redacción permite asegurar de forma específica su alcance y es complementario a los diferentes pasos indicados en el procedimiento al momento de fabricar una nueva parte que posteriormente será instalada en el curso del mantenimiento de aeronaves y componentes dentro de sus instalaciones.

Por otro lado, el objetivo del proyecto también planteaba formular una propuesta de implementación capaz de relatar las ventajas y limitaciones que podrían tener las organizaciones EASA Part-145 al incorporar procesos de fabricación de partes en el curso de las tareas de mantenimiento en aeronaves y componentes realizados en sus propias instalaciones, es así como se dedicó el capítulo 3 de este trabajo de fin de máster, para detallar una guía de un caso de negocio que puede ser seguido como instrumento de un modelo descriptivo donde se detallan las pautas generales a tener en cuenta para presentar la propuesta de implementación, también se destacan las ventajas y restricciones a las que se pueden ver inmersas las organizaciones de mantenimiento con esta iniciativa. Es importante anotar que los costes de equipos, materiales y adecuaciones físicas de las facilidades deben ser ajustadas en modo, tiempo y lugar donde se pretenda incorporar este procedimiento todo esto para que se garantice tener una base de costes real y un análisis financiero óptimo.

Finalmente, y como se ha identificado a lo largo del proyecto, adoptar este tipo de procedimientos dentro de las capacidades de las organizaciones de mantenimiento EASA Part-145, sin duda ayudara a optimizar los procesos de reparación de aeronaves y componentes, y de la misma manera abre la puerta para que nuevos procesos también puedan ser analizados bajo este concepto, y así tener más herramientas enmarcados en los procesos de la industria del mantenimiento aeronáutico avaladas por las autoridades regulatorias., teniendo en cuenta que esto se constituye como una opción para que las organizaciones de mantenimiento se puedan autoabastecer de repuestos.

Bibliografia

- [1] EASA Part 145. Annex II to ED Decision 2019/009/R Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Annex II (Part-145) to Commission Regulation (EU) No 1321/2014 Issue 2 — Amendment 2 (pp.8)
<https://www.easa.europa.eu/sites/default/files/dfu/Annex%20II%20to%20ED%20Decision%202019-009-R.pdf>
- [2] USER GUIA # UG.CAO.00131-002, “Foreign Part-145 approvals - Fabrication of Parts”
https://www.easa.europa.eu/sites/default/files/dfu/B13.%20UG.CAO_.00131-002%20Fabrication%20of%20parts.pdf
- [3] USER GUIA # UG.CAO.00024-008- “User Guide for Maintenance Organisation Exposition”
https://www.easa.europa.eu/sites/default/files/dfu/B01.UG_.CAO_.00024-008%20User%20Guide%20for%20Maintenance%20Organisation%20Exposition.PDF
- [4] AIPS03-02-008 - Airbus Process Specification - Thermoforming of thermoplastic sheet materials <https://w3.airbus.com/>
- [5] IPS03-02-008 - Instruction Process Specification - Thermoforming of thermoplastic sheet materials <https://w3.airbus.com/>
- [6] Airbus Process and Material Specification PMS 02-12-10; PMS 02-12-07; PMS 02-12-23 <https://w3.airbus.com/>

Anexo A

“Procedure Thermoforming of Thermoplastic Sheet Materials (PTTSM)”,

PROCEDURE
THERMOFORMING OF THERMOPLASTIC SHEET MATERIALS
(PTTSM)

First Edition
Revision 0

19 Oct 2020

APPROVAL OF THE REVIEW AND CONTROL OF THE
DISTRIBUTION:

All reviews will be reviewed by the Quality Director, accepted by the Technical Director,
and approved by the Responsible Manager.

Original Edition Date	Actual Revision	Revised Quality Manager	Accepted Technical Manager	Approved Accountable Manager
1 19/10/20	0 19/10/20	Name and Sign	Name and Sign	Name and Sign

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Record of Revisions

The Record of Revisions is to control all revisions of the procedure, indicating revision number, revision date and subject. This page is not revised and keeps the date of the first issued in a way that the person who signs and updates the consecutive revisions can easily check the incorporation of every revision.

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NUMBER REVISION	DATE REVISION	SUBJECT
0	19/10/20	Initial issue

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Part A. General

1. General

1.1. Purpose

The purpose of this document is to provide a procedure and managements to Maintenance Organizations and Engineering personnel giving acceptable methods for compliance with regulatory requirements and statements to manufacture thermoformed products that will be installed during the maintenance and repair procedures to aircrafts and their components.

1.2. Scope

This procedure gives acceptable methods that must be followed to manufacture thermoforming thermoplastics products under the authorization contained in the applicable regulation. The scope includes: Rule and policies management responsibilities, description, and classification of the products to be thermoformed, personnel qualifications, Quality inspection procedures, engineering procedures, and other pertinent information.

1.3. Responsibilities

All maintenance personnel must comply with the duties/responsibilities and procedures contained in this document. The Maintenance Chief is responsible for the content, accuracy, and revisions. Any revisions conducted in this procedure shall be submitted by Technical Manager to the Regulatory Compliance department for acceptance. This document shall be submitted by Quality Manager to be assigned to Authorities Office for acceptance prior to implementation.

1.4. Information deficiency

If any employee find deficiencies which need to be clarified, or want to suggest any improvements regarding to the contents of this Procedure, must identify the item and inform to their supervisor in order to fill a requirement and forward it to the Technical Manager for acceptance.

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2. Document Structure

The Procedure Thermoforming of Thermoplastic Sheet Materials (PTTSM) is issued in electronic form and is structured as follows:

- a. Table of Contents - Located in the front page of this document, will list the parts titles and beginning page number. It will also show the change status of each part and section.
- b. Record of Changes - Provides space for recording insertion of revisions, this include the List of Effective Pages.
- c. Parts - Sequentially identified with Capital letters.
- d. Sections - Sequentially numbered with Arabic numbers beginning with number one (1), followed by a decimal (.) as appropriate.
- e. Pages - Pages are sequentially numbered. This number is located on the upper corner of each page.
 - Revision number - A number will be shown in the top of each page, indicating the revision number of that page.
 - Date - Date of revision each page will be listed on the top of each page, under the revision number. This mean the latest revision date for that page. The date format will be listed as Day/Month/Year, e.g., 01/22/20.

3. Revision System

The revision system provides methods to ensure that new information can be incorporated into the accepted document. The Revision system must comply with the accepted procedures within the internal Quality Control Manual of the Maintenance Organization.

- a. The basic document is revised on as-needed basis using the following method.

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- Routine Revisions - The routine method of revision is done by issuing page changes, as required, which contain all needed changes developed by the date of issue.
- b. Action to correct misspelled words or to improve sentence structure will be held until a routine revision is made.

3.1. Revisions Responsibilities

3.1.1. Maintenance Chief is responsible for:

- a. Assure the Guidelines meet regulatory compliance.
- b. Assure that any change which affects the procedures will be implemented within this document prior to be developed in the shop practices.
- c. Ensure that changes of the specification of the manufactures are incorporated into this document.
- d. Control of changes for these guidelines.
- e. Make the Guidelines available to any person performing maintenance activities related with thermoforming process.
- f. Send the original copy to Technical Library once it has been accepted for distribution purpose.
- g. Develop the technical procedures which must be done during the thermoforming process.
- h. Is responsible for keeping updated the content of this document and use only, current, correct, and approved or acceptable data.

3.1.2. Regulatory Compliance Department:

- a. Assure the Guidelines meet regulatory compliance.
- b. Revise the changes of the procedure thermoforming of thermoplastic sheet materials.
- c. After reviewing the changes, submit the PTTSM to the applicable authorities.

3.1.3. Users are responsible for:

- a. Request any improvement and change to Quality Manager or Maintenance Chief about the information contain herein.
- b. Use, keep, and control assigned document.

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- c. Each person issued a copy of this procedure is responsible for inserting all revisions and being familiar with its contents.
- d. Personnel making copies of this document must follow the procedures described in regulatory manuals.

NOTE: Any copies or sections of the procedure must be destroyed or disposed of after use. These copied pages or sections are not to be stored, filed, or stockpiled.

4. List of Effective Pages (LEP)

The "List of Effective Pages" or LEP contains a table of sections, and page numbers within each section, with a revision date and number. The same information will appear in the footer (or header) of each corresponding page.

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Part B. Regulatory Compliance

1. Intent

This Part B, provides guidelines on the interpretation and compliance of the European Union Aviation Safety Agency – (EASA) regulations related with the process required to fabrication of parts by the approved maintenance organization (fabrication of the thermoforming thermoplastics products) under an equivalent level of safety.

2. Applicability

The provision contained in this Procedure must be in accordance with the guideline's procedures accepted by the regulatory authorities established in the following approvals documents:

- Maintenance Organization Exposition (MOE)
- Certificate of Operations Specifications.

3. Background

Many elements affect the nature of the repair processes to the aircrafts and their components, including delays or long spare parts lead time, problems that can be reflected in the cosmetic aspect of the passenger cabin and that affect the customer services. For this reason, the maintenance group raised the need to obtain an approved capacity to manufacture NON-CRITICAL thermoforming thermoplastic products applicable to cosmetic parts, that is, a fabricated part, the failure of which would have no effect on the continued safe flight and landing of the aircraft.

4. Regulatory Compliance

- a. The procedures contained in this document have been developed taking into account the authorization established in the following regulations:
 - **AMC1 145.A.42(b)(iii) Components. - FABRICATION OF PARTS FOR INSTALLATION Item (d).** *Items that are fabricated by an organization approved under Part-145 may only be used by that organization in the course of overhaul, maintenance, modifications, or repair of aircraft or components,*

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performing work at its own facilities. The permission to fabricate does not constitute approval for manufacture, or to supply externally, and the parts do not qualify for EASA Form 1 Annex II to ED Decision 2019/009/R Page 9 of 17 certification. This prohibition also applies to the bulk transfer of surplus inventory, in that locally fabricated parts are physically segregated and excluded from any delivery certification.

- b. The thermoforming procedures have been developed taken into account acceptable data established in Airbus Process Specification AIPS03-02-008 (Thermoforming of thermoplastic sheet materials), and this Procedure Thermoforming of the Thermoplastics Sheet Materials (PTTSM) was developed as part of the acceptable data to determine conformance of all processed-thermoformed parts with applicable regulatory requirements and airworthiness standards.
- c. The reverse engineering method was used to develop the process contained within this procedure. This method was applied to develop the drawings and technical specifications of the final product to be fabricate.

5. References

- a) AMC1 145.A.42(b)(iii) Components. - FABRICATION OF PARTS FOR INSTALLATION
- b) Specification AIPS03-02-008
- c) Specification PMS 02-12-03 - PMS 02-12-07 - PMS 02-12-10.

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Part C. Product Classification

Description and Classification of Products to be Fabricate

1. Part Classification

The thermoformed products in this procedure have been classified as a part category Non-Critical. The products Thermoformed are used for cosmetic purposes and its failure would have no effect on the continued safe flight and landing of the aircraft. The product of a category Non-critical part will require only acceptable data that are being developed in accordance with Part F - (Engineering) on this procedure.

Additionally, changes to the Instructions for Continued Airworthiness (ICA's) of products produced under this procedure are not affected. The products do not involve ICA's.

2. Technical Description

The products which this process is applicable are defined in the following table:

PRODUCT CATEGORY	DESCRIPTION	MATERIAL
Thermoplastic	Thermoplastic Non reticulated, with amorphous structure.	Polyvinyl Chloride – PVC Acrylonitrile-Butadine-Styrene - ABS
Thermoplastic	Thermoplastic Non reticulated, with semi-crystalline and amorphous structure	Polycarbonate PC

Table 3.1. Product description

2.1. Material Specification

The thermoplastic material, to be used in accordance with Airbus Process and Material Specification:

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TYPE	Nº	DESIGNATION	CODE MATERIALS
PMS	02-12-10	Acrylonitrile-Butadine-Styrene - ABS	5.587
	02-12-07	Polyvinyl Chloride – PVC	5.583
	02-12-23	Polycarbonate	5.575

Table 3.2. Thermoplastic Material Specification

NOTE: The appendix contains the List of commercial products that can be used and meet the Process and Materials Specifications (PMS), refer to Table 3.2 (Thermoplastic Material Specification).

The Engineering Group is responsible for approving any material that can be used as an alternate and must be included in the list of Appendix., as being required.

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Part D. Facilities, Equipment and Tools

1. Facilities

The facilities for thermoforming process shall be free of contaminants, well ventilated/illuminated.

Adequate storage facilities for sheet materials and formed parts (pre-shipment) shall be available. They shall be protected against moisture, damage, and contamination.

Adequate storage facilities for molding tools shall be available. They shall be protected against damages and loss.

They must not be exposed to moisture (e.g. condensation, rainwater) during transport and storage.

The storage conditions for each specific material shall be those indicated in the corresponding material specification, individual product specification or process instruction. All limited life materials used shall be within their useful lifetime (storage life and work life). The materials shall be stored in the original packages with marking to ensure a clear identification.

2. Equipment and Tooling

NOTE: Read the manufacturer's manual for each machine or equipment carefully before operation to prevent damage of the equipment or personal injuries.

All tooling and equipment used in the manufacturing process shall be tested and approved prior to use.

3. Thermoforming equipment

The thermoforming machine shall be equipped with:

- Lightning for the sheet to be formed
- Upper heating or lower heating (upper heating for the tool and the sheet, lower heating additionally for the sheet)
- Connections for air cooling
- Vacuum unit with minimum pressure differential of 0,85 bar ($\pm 0,2$ bar absolute pressure)

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- Blast chamber fitted with an adjustable system for filtered compressed air, producing a cushion of air to prevent excessive sagging of the plate. The compressed air is also used to release the component.
- Hydraulic or pneumatic lift mechanism
- Heating power system
- Clamping frame

For materials which must be thermoformed at temperatures above 180°C automatically operated equipment provided with double sided heating elements shall be available.

The thermoformed machine shall be equipped with a measuring device to monitors the process parameters (forming time, heating time and heating temperature).

The compressed air shall be free from oil and other contaminations, and heating elements shall distribute the temperature homogeneously.

- a. The machine recommended is described in the following table:

Machine Model	Comet Model C54S
Manufacturer	Maac
Station work	Single
Sheet dimension	152.4 x 121.92 cm
Thermoforming area	Adjustable Clamp Frames 150 X 120 cm
Vacuum motor	3 HP
Heating Power	72160 w
Electrical Power	480 Volts, 3 Phase, 60 Hertz
Dimensions	4110.5 x 3118 x 2730.5 mm
Weight approx.	3.5 Ton

Table 4.1. Thermoforming Machine Specifications – Recommended

4. Temper equipment

The temperature indicating equipment shall provide accuracy commensurate with the processing tolerance contained in this process. The tool for controlling the temperature could be analogous or digital device.

The temper equipment shall be suitable to temper the thermoformed parts to reduce internal stress caused by the thermoforming process.

The oven shall have the ability to adjust the needed temperature with suitable tolerances.

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The temper oven shall be equipped with a measuring device to monitors the process parameters (annealing temperature and annealing time).

- a. Use Fluke 568 Contact & Infrared Temp Gun or equivalent

Model	568
Manufacturer	Fluke
Infrared temperature range	Single 40°C to 800°C (-40°F to 1472°F)
Infrared accuracy	< 0°C (32°F): $\pm(1.0^{\circ}\text{C} (\pm 2.0^{\circ}\text{F}) + 0.1^{\circ}/1^{\circ}\text{C or}^{\circ}\text{F})$; > 0°C (32°F): $\pm 1\%$ or $\pm 1.0^{\circ}\text{C} (\pm 2.0^{\circ}\text{F})$, whichever is greater
D:S (distance measurement spot size)	50:1

Table 4.2. Infrared Temp Specifications – Recommended

5. Cabinet Dryers

The dryer shall be suitable to dry the sheet material in such a way to ensure that the material will not affect negatively.

The dryer shall distribute the heat homogeneously.

The dryer shall be able to monitors the drying process.

The dryer shall be able to record the process parameters (drying time and drying temperature). An air circulating oven is required for pre-drying. The oven shall monitor the moisture content of the dryer inlet air.

- a. Use Cabinet Dryers or equivalent

Model	CD-20
Manufacturer	Chini Plastics
Heater(kW)	9
Blower (kW, 50/60 Hz)	1.5
Highest Temp. (°C)	200
Total Capacity (kg)	200

Table 4.2. Cabinet Dryers Specifications - Recommended

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6. Permanent Marking Tool

The Laser Marking System shall be utilized in the marking process to the thermoforming products to provide a permanent and legible marking, another alternative is to use SHARPIE PERMANENT MARKER.

7. Cutting equipment

The cutting equipment shall be cut the sheet material in such a way to avoid any damages on the cut edges.

The cutting equipment shall be able to cut the sheet material regarding the specific material behavior.

Trim machine, high-speed CNC machining centers with 5 axis simultaneous operations, and is used in the thermoforming process to ensure: performance, short machining times, flexibility, and high-quality surface finishes.

Refer to: Belloti industries or Comi SpA

8. Mold

The mold design shall be such that the shrinkage of the product material and differences in thermal expansion between the product material and mold material are taken into account in order to ensure that the final product meets the dimensional requirements of the product drawing and/or associated documents.

- The mold material shall be suitable for material specific forming temperature.
- The mold material shall be resistance to material characteristic mold temperature.
- The mold shall have enough suction holes to evacuate the mold.

9. Maintenance and Calibration of Equipment -MCE

The equipment must be maintained and calibrated according to the manufacturer's instructions using the management, control and maintenance of equipment and tools of

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internal document process. Each calibration standard is traceable to a standard acceptable to the applicable aeronautical authority.

This program shall include the equipment and tools used to perform thermoforming procedures.

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Part E. Thermoforming Quality Control System

1. General

This Part provides information and guidance concerning the specific aspects of the Quality System for thermoforming products. The Quality System establish and implement a plan which verifies the parameters affecting product integrity and operating under controlled conditions, individual items, batches, or lots conform to specified quality standards.

2. Materials Control

- a. Subcontractor control (Parts and material provided). The Contracts and Warranties Manager will perform the control and monitoring to subcontractors.
- b. The materials used to manufacture thermoformed parts will be approved by the Engineering group; these materials must be received and inspected by incoming Inspection.

In Shop the Quality Control Inspector assigned, must verify the receiving tag and the materials for being used prior to develop any thermoforming process. This procedure requires the record of the incoming material that is being received in the shop. Enter the information requested on Form THERM-01 (see, forms) which must be affixed to each piece of material in order to keep the traceability of the raw material.

- c. Before using any material in the Thermoforming process, you should be consult and use the information described in the MSDS for each material, to know the risks and the identity of the chemicals, also know the proper handling of hazardous substances.

3. Approved Products

- a. Each product to be thermoformed must follow the internal procedures described in Part F - (Engineering Process) of this procedure.
- b. The Shop will be responsible to develop the product and mold drawings in electronic format and will be sent to Engineering group for approval or rejection. If approved, Engineering shall issue a approve letter showing the number of drawing for the product and mold.

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- c. The maintenance chief will be responsible for maintain the updated status Design Data that were approved by the Engineering Group for manufacturing, every time issue a new revision in the Design Data for any product, the maintenance chief must update the information of approved parts in format "Authorized Products to be Fabricated" (THERM-05), Refer to Appendix Forms. current version. This ensures that personnel only will use the updated Design Data.
- d. The list of parts fabricated by nomenclature and part number will be issued using the format THERM-05 "Authorized Products to be Fabricated" Refer to Appendix Forms. current version. This format will be maintained and updated by the maintenance chief and will be available for consultation on the internal technical repository.
- e. The technical library shall controlled and maintain available this Process Thermoforming of Thermoplastic Sheet Materials (PTTSM) and documents accepted (Drawing Product, Drawing Mold, Engineering Order, Approved Letter) for each product approved by the Engineering Group on its current version to personnel assigned to Thermoforming Shop and will be available for consultation on the internal technical repository.

4. Handling and Storage (materials and products)

- a. Handling and Storage of sheet materials and products shall be as follows:
 - Store sheets in a horizontal position to prevent deformation by buckling in the material. Place small sheets on top of larger ones to avoid overhang supports.
 - The sheets must be stored in the original package.
 - The thermoplastic sheets and products are not affected by humidity and shelf life control.
 - Store sheets and formed products in areas where the temperature is less than 100°F (38°C) to prevent distortion.
 - Thermoformed products must be clearly identified and stored in plastic bags or stretch Film to prevent contamination.

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5. Personnel Training Requirements

All the work steps of the manufacturing procedure shall be carried out by authorized, trained and competent personnel recognized by an approval training program.

The personnel being involved in the thermoforming of thermoplastic products must be trained in accordance with the approved Training Program, considering the following topics:

1. Thermoplastics and thermoforming theory and procedures.
2. Theoretical and practical training in thermoforming process.
3. Be familiar with the procedures and policies established in this procedure.
4. Be familiar with procedures established in regulatory manuals.

A list of personal authorized to perform thermoforming process must be controlled by the maintenance chief. This list must indicate the Technicians and Inspectors personnel authorized to approve the products.

NOTE: The personnel involved in the thermoforming process must be trained in the specific manufacturing procedures but is not necessarily technical qualification in aircraft maintenance, therefore it is not necessary to be an aircraft maintenance technician for develop these procedures.

6. Thermoforming Process

- a. The Quality Control Inspector verifies that the procedures for thermoforming products and in-progress inspection must be in accordance with the Thermoforming Procedure form (THERM-04), included in the appendix Forms.
- b. The handling of sheets must avoid rough treatment during the process.
- c. Destruction of Replaced Material. Material replaced by the thermoforming part should be mutilated/destroyed beyond any possibility of repair or reassembly and should not be retained for future use.

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- **Tooling**

1. Heated tooling shall be used to produce acceptable products. The tool temperature range must be the value specified (and validated) in the manufacturer's data sheet for obtaining the optimum forming temperature.
2. Tools should be made of smooth material which minimizes marks or distortion on products.

- **Forming**

1. Heat the material to the appropriate temperature using the validated manufacturer's data sheet as a guide to allow forming to the desired configuration. Discoloration of the material during forming is not permitted. Forming temperature may be adjusted outside the temperature ranges according with manufacturer's data sheet to obtain optimum products.
2. Approved alternative methods for determining heating time and forming temperature are as follows:
 - Use an infrared pyrometer to determine the sheet temperature as it is heated.
 - Use three temperature-sensing elements on each surface of the material.

7. Acceptance of Thermoformed Products

The thermoformed products must be inspected by the authorized quality Inspector to accept them in accordance with the required physical, chemical, and dimensional properties. The inspector must verify the product that:

- a. Production parts shall be uniform in quality and appropriate in dimensions (in accordance with the drawing). The formed parts shall be free of defects listed below:
 - Cracks
 - Bubbles
 - Varying degrees of brightness
 - Material defects caused by forming process
 - Webbing (fold formation)
 - Scratches
 - Stains

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and any other elements which may be detrimental to the performance of the part.

- b. No visible burrs are allowed on edges visible to the cabin interior. Visible applies to defects detected at a distance of 20 to 30 centimeters with normal corrected vision under standard shop or lab lighting.
- c. Chips, scratches, and gouges within 0.063 inch of the trimmed edge or hole are allowed. No chips, scratches, or gouges are allowed on edges or surfaces visible to the cabin interior

NOTE 1: During the thermoforming process, the flammability requirements by Certification Specification CS 25.853 are not affected, since the thermoforming temperature is within the range established in Manufacturer's data sheet.

NOTE 2: The quality control inspector must mark with his stamp at the identification form THERM-01 once the acceptance inspection has determined that the product complies with the above technical specifications.

8. Records

- a. Each thermoformed product must have its associated records which can demonstrate the compliance with the technical and regulatory requirements. The thermoforming and inspection records and status that must be attached to each fabricated product are:
 - Drawing of products thermoformed
 - Thermoforming Procedure form (THERM-04)
 - Thermoformed Products Control (THERM-03)
 - Non-conformity Product Control (THERM-02)
- b. The fabrication records of the thermoforming products must be retained and preserved for a period of two (2) years in the Technical Records Department.

9. Thermoformed Products Marking

- a. Thermoforming products must be clearly identified with a permanent and legible marking. The Laser Marking System will be utilized in this process to provide a permanent marking or other alternative is to use SHARPIE PERMANENT

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MARKER. The technician must follow the following instructions to identify the piece:

- Once the thermoforming product has been approved by the Quality Inspector, the technician should mark it on the back using the form THERM-01 (see Appendix Forms).
- To control the fabrication of the thermoforming products, the name of the Organization Maintenance trademark and EASA certificate number, must be including in the Form THERM-01.
- A unique part number (P/N) must be clearly distinguished in the fabricated part. The part number for each product is the same as the original part number and adding an EPA, (ie, OEM P/N DM012345 then NEW P/N is DM012345-EPA).
- The original manufacturer's part number must be including in the Form THERM-01.
- To release the thermoforming product, the Quality Inspector should be affixed his stamp, certifying that the piece has been approved.

10. Non-Conformity Products

- a. The products that do not accomplish the specifications and the established-on Part E section 7 of this procedure must be permanently destroyed (Cutting, Sawing, Hammering) and scraped. The products or materials rejected shall be controlled and recorded as non-conformity products. Use the THERM-02 during the process (see Appendix Forms). The final disposition of reject parts must be placed in a special container marked "rejected parts". This data could be required by quality assurance for verification.
- b. In process feedback. The quality control inspector shall submit a report to the maintenance chief about non-conformity products or materials in order to implement corrective and preventive actions during the process, these actions will be analyze and discuss between the quality inspector, the maintenance chief and the Engineering group if as required.
- c. In Service feedback. If the customer identifies repeated reports about products that have been manufactured and released into the shop and these in service are non-conformity, these should be returned to shop to be reviewed in order to implement

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corrective action, these action will be analyzed and discussed between the quality control inspector, the engineering group and the maintenance chief. These data shall be recorded and stored by the Maintenance Chief in order to keep historical information of the corrective actions that have been taken and could be applied as future improvements to nonconforming products. This data could be required by quality assurance for verification.

- d. If there were found products or articles that have been released from the quality system and that do not conform to the applicable design data or quality system requirements. The maintenance chief will determine in which aircraft or components were installed this products, and he will send a detailed report to the customer including also the director of quality of the maintenance organization in order to analyze and take corrective actions.

11. Thermoforming of Multiple Products

- a. The thermoforming products will be used for maintenance process as stipulated by AMC1 145.A.42(b)(iii) Components; FABRICATION OF PARTS FOR INSTALLATION.
- b. A quantity of identical parts with the same part number may be fabricate at the same time, providing it will be consumed in later repairs made by maintenance organization, to control the traceability the thermoforming products the shop will issue a certificate of conformance “C of C” with all information about the manufacturing.
- c. The shop must control the thermoforming products to demonstrate the final disposition of the product. This control must be carrying out in the form THERM-03 (see Appendix Forms)

12. Quality Assurance Audits

- a. An annual audit must be performed by Quality Assurance Personnel who must verify the quality standards that must be carried out in accordance with the technical and regulatory procedures. Additional audits can be performed based on operational requirements or shop performance.
- b. A record of these audits must be retained by a period of two (2) years and must be available for authority’s verification.

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- c. Internal audits. Planning, conducting, and documenting internal audits are established in the regulatory manuals. The maintenance chief is responsible for determining and initiating corrective action needed to correct nonconformity or correct its cause.

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Part F. Engineering Process

1. General

- a. The thermoforming process of the products and tooling used must be developed using whichever one of the following methods:
 - Original Equipment Manufacturer data (material specification, drawings, etc).
 - Reverse engineering methods.
- b. The above methods will be used depending the information available and must guarantee the compliance of the technical and regulatory requirements established.

2. Reverse Engineering

2.1. Product Development:

- a. During this method is useful to determine the original properties of the product to be produced without availability of original drawings. The reverse engineering is used to process of reconstructing an existing object. in this case the design engineer starts with the final product and works through the design process in the opposite direction to arrive at the product design specification. During the process, vital information about the design concept and manufacturing methods is discovered.

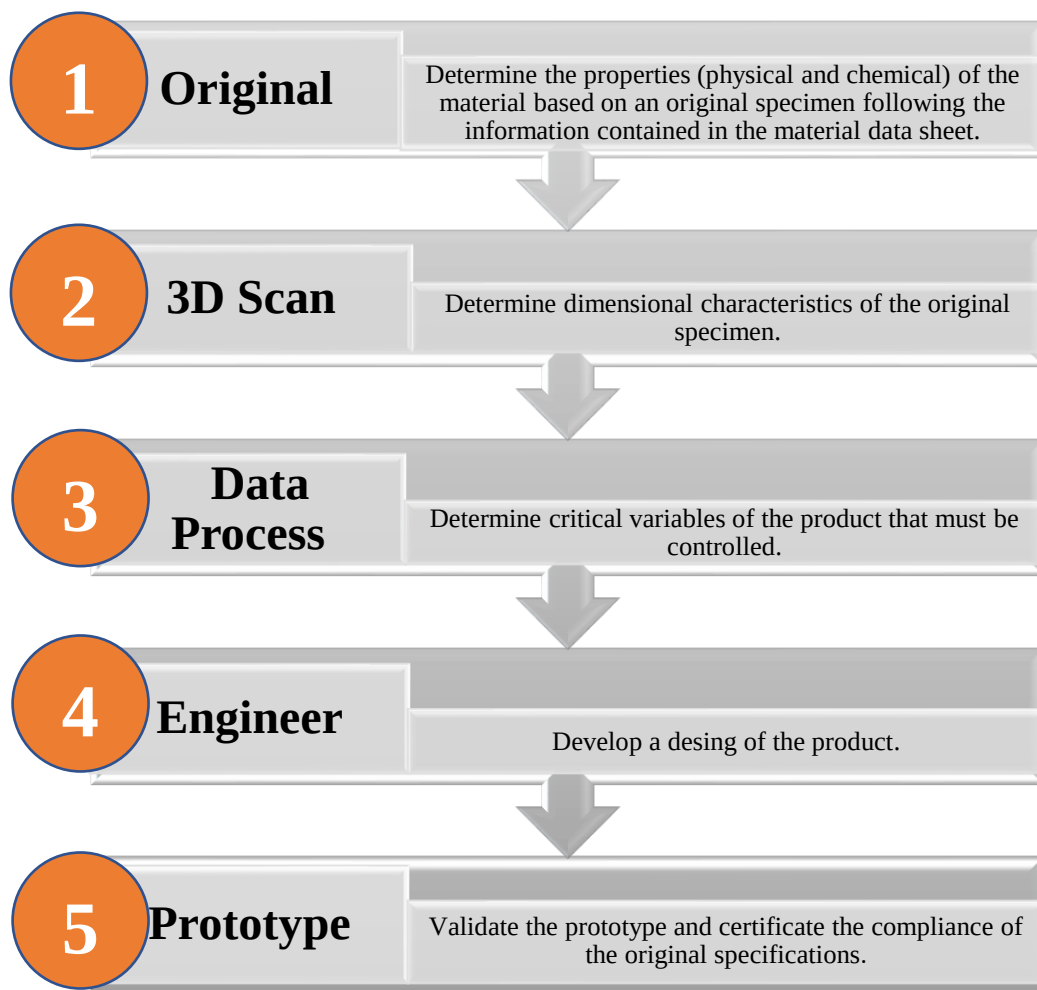
The process of reverse engineering begins by gaining dimensional information of the object via 3D scanning of a product thermoplastic.

Reverse engineering involves acquiring three-dimensional positional data in the point cloud. There are many ways of gathering valuable dimensional information about the product, but using an accurate 3D measuring system is paramount. The accuracy of the data captured will impact the quality and deviation of the Reverse Engineered model when compared to the original. The scanning systems 3D offer highly accurate, traceable, and repeatable measurement. The surface data captured is then passed to our in-house design team to establish the original design intent of the object.

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- b. The Engineering Group must develop an evaluation of the thermoplastic product in accordance with the following workflow to validate the properties of the product and qualify of the thermoforming process.

Product Development workflow



- c. The properties of the thermoplastic materials shall be determined using specialized laboratories facilities and must include as minimum the following tests:

1. Rheology test.

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2. DSC, Differential Scanning Calorimetric.
3. Mid Infrared Spectroscopy

Refer to UL - Plastic Testing Laboratory - ulttc.com

- ASTM E1269-05 - Determination Specific Heat Capacity by DSC
 - ASTM D3418-03 - Transition Temperatures of Polymers By DSC
 - ASTM D1238, ASTM D3364 - Melt Flow Rate
 - ASTM D1243, ASTM 2857, ASTM D4603 - Dilute Solution Viscosity Measurements
 - ASTM D635 - Flammability
- d. The procedure for obtaining dimensional data from the product could be done by two ways:
 1. Make measurement using traditional devices such as calipers and gauges and entering the results into standard CAD system.
 2. Use of advanced computational techniques which digitalize the dimensions in automatic modes.
 - e. The critical variables of the product to be fabricated must be determinate taken in to account the specification of the product and the operational requirements. These variables must be controlled during the whole fabrication process and must be verified to determine their accuracy and limits established.
 - f. The product must demonstrate that is functionally acceptable, by this reason, a series of pilot tests must be developed to guarantee the compliance of the technical specifications.
 - g. The validation of the product must include:
 1. Statistical control of the critical variables.
 2. Dimensional specifications that can validate the drawing of the product.
 3. Functionality tests.
 - h. Taken into account the above information, each fabricated product must contain a file with the following information:

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1. A drawing of the product which includes technical specifications (material and dimensions).
2. A drawing of the mold which includes technical specifications (material and dimensions).
3. An Engineering Order which describes the procedures used to fabricate the mold.
4. A technical data sheet which will be used as a reference during the fabrication process for the thermoforming.
5. Criteria for technical acceptance, it means, critical variables that must be controlled during the process.

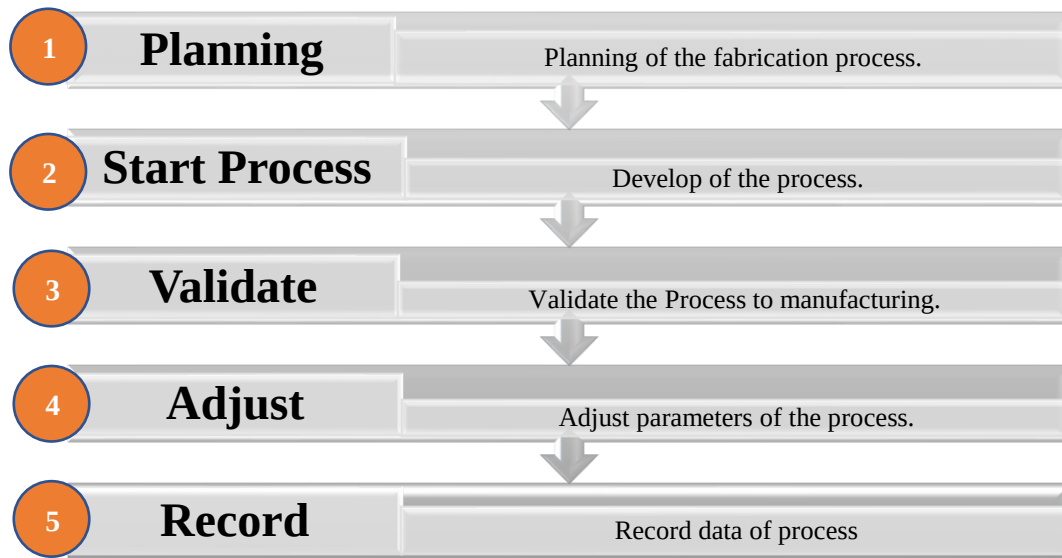
2.2. Process Development

- a. Is necessary to carry out an evaluation of the fabrication process which includes an analysis of the variables and parameters to be controlled. This evaluation must be done developed by Engineering group.
- b. The following workflow must be used as a guide to develop the process:

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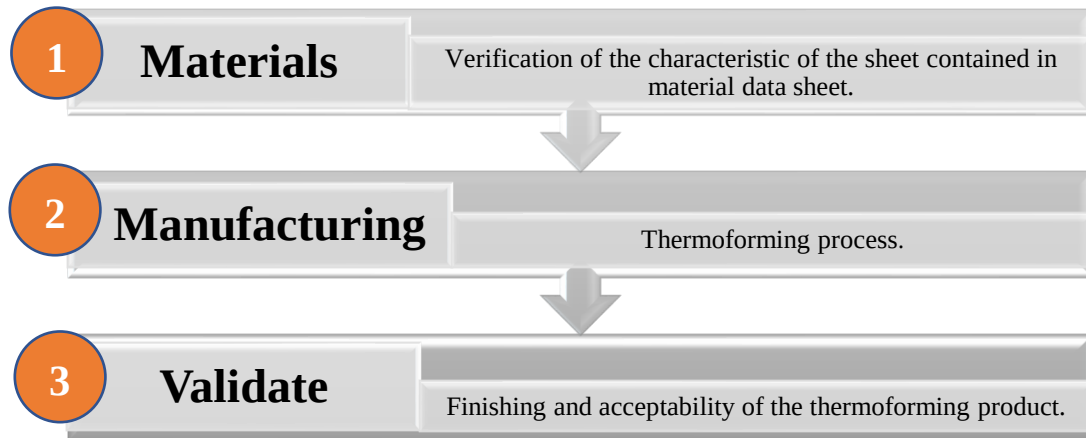
Process Development workflow



- c. The Planning of the thermoforming process should include:
1. Production requirements (requisites and capacity).
 2. Analysis of the technology required.
 3. Determine the material and method of the fabrication of the molds and tooling required for the fabrication.
- d. In the development of the process is necessary to determine stages of the process and variables that must be controlled. The following workflow serve as a guide:

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Process stages



e. Is necessary to determine a statistical control of the following variables:

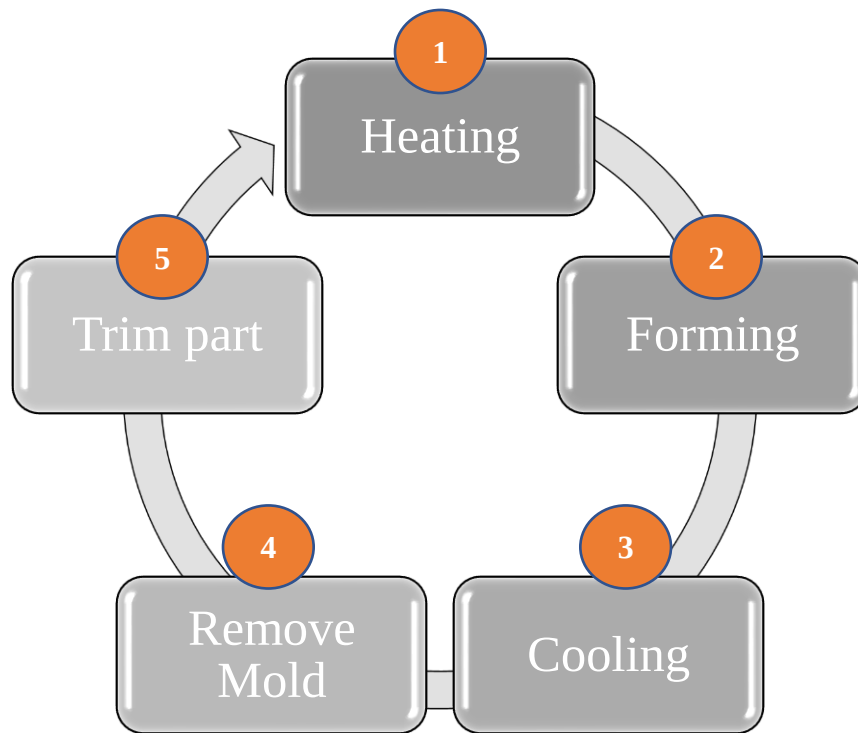
- Thickness of the sheet
- Stretching Rate (RA)
- Weight Rate
- Longitudinal and Transversal Stretching

NOTE: These parameters are required for a first-time material and for controlling when a new sheet supplier has been considered.

f. The thermoforming process must be developed taking into account the temperatures and time required in each step of the process. This can be described in a thermoforming curve. This curve must include the thermoforming cycle:

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Thermoforming cycle



- g. The validation of the process must describe:
1. Mold validation
 2. Process capacity validation
 3. Control elements validation
 4. Process stage validation
 5. Process capacity measurement
 6. Adjust Statistical Process Control
 7. Training of the process.
- h. The process must be adjusted according with the specifications of the product that will be thermoformed.
- i. Record the tests performed during the process to support the analysis and results of the materials. This document should have its associated records where each

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part number of the thermoformed products can demonstrate compliance with the technical requirements.

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Appendix

1. List of qualified materials

A. LEXAN F6000 SHEET

Properties of the Material

Lexan* F6000 sheet is a flame-retardant opaque polycarbonate sheet range available in standard and custom colors. In addition to good flammability performance, it offers excellent impact resistance, good stiffness and strength and ease of processing, making it suitable for a wide variety of applications in industries such as electrical/electronic and transportation (e.g. aircraft, rail).

Property	Test Method	Typical Value
Specific Gravity	DIN 53479	1.21
Tensile Strength	DIN 53455	62 MPa
Flexural Strength	DIN 53452	90 MPa
Flexural Modulus	DIN 53457	2240 MPa
Izod Notched Impact	ASTM D256	640 J/m
Gardner Impact, 20°C	SABIC Method	>40 J
Thermal Expansion	VDE 0304/1	6.8x10 ⁻⁵ m/m °C
UL Flammability	UL94	V0 (1.47) mm
FAA Flammability	FAR 25.853	Pass (1-6) mm
	(a), 1, (i) &(ii)&(iv)	Pass (1-6) mm
NBS Smoke, flaming mode, DS, 1.5min	ASTM E662	<50
DS, 4.0min		<100
ABD0031	AITM 3.0005	Pass

NOTE 1: The above information was obtained from Lexan specification data sheet.

NOTE 2: For additional information, go to www.sabic-ip.com

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B. BOLTARON 9815

Properties of the Material

Boltaron 9815 is a proprietary, fire retardant, press laminated thermoplastic sheet designed to meet stringent FAA requirements for flammability, smoke generation and heat release as set forth in FAR 25.853 paragraphs (a) and (d). Boltaron 9815 offers excellent impact strength, abrasion resistance, stain, and chemical resistance, and superior thermoformability.

Property	Test Method	Typical Value
Specific Gravity	ASTM D-792	1.49
Tensile Strength	ASTM D-638	5,800-6,400
Flexural Strength	ASTM D-790	10,000-10,500
Flexural Modulus	ASTM D-790	4.4-4.6x10
Izod Notched Impact	ASTM D-256	1-2
Hardness Rockwell	ASTM D-785	112-115
Heat Deflection (°F)	ASTM D-648	168-172
Mold Shrinkage	In./In.	0.005 - 0.007
Flammability FAA	FAR 25.853 A1,(i)	PASS
	FAR 25.853 A1,(ii)	PASS
Thermal Expansion	D-696	3 x 10
Forming Temperature (°F)		335 - 365

NOTE 1: The above information was obtained from Boltaron specification data sheet.

NOTE 2: For additional information, go to www.boltaron.com

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C. KYDEX T

Properties of the Material

KYDEX T is a proprietary thermoplastic sheet that is cost competitive with fire retardant ABS/PVC (FR-ABS) formulations but with significant higher impact strength and extensibility.

Property	Test Method	Typical Value
Specific Gravity	ASTM D-792	1.35
Tensile Strength	ASTM D-638	42 MPa / 6,100 psi
Flexural Strength	ASTM D-790	66 MPa / 9,600 psi
Flexural Modulus	ASTM D-790	2,480 MPa / 360,000 psi
Izod Notched Impact	ASTM D-256	801 J/m – 15 ft-lbs/in
Hardness Rockwell	ASTM D-785	94
Heat Deflection (°F)	ASTM D-648	75.6 °C – 168 °C
Flamability: Underwriter`s Laboratories, Inc.	UL Standard 94	V-0, 5V
DIN 5510-2		0.90mm (S4, ST2, SR2)
		6.20mm (S4, ST2, SR2)
Federal Aviation Administration	FAR 25.853 (a)	PASS

NOTE 1: The above information was obtained from Kydex T specification data sheet.

NOTE 2: For additional information, go to www.kydex.com

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D. ROYALITE R57

Properties of the Material

ROYALITE R57 thermoplastic sheet is a rigid, fire-rated*, ABS/PVC product that combines lightweight with very high impact strength, high tensile strength and stiffness, and excellent formability and ductility. Royalite R57 meets Federal Aviation requirements for flammability as well as Airbus and Boeing toxicity requirements.

Property	Test Method	Typical Value
Specific Gravity	ASTM D-792	1.18 – 1.26
Tensile Strength	ASTM D-638	4800 psi
Flexural Strength	ASTM D-790	7700 psi
Flexural Modulus	ASTM D-790	2.8 (105) psi
Izod Notched Impact	ASTM D-256	8.0 ft-lb/in notch
Hardness Rockwell	ASTM D-785	93
Heat Deflection (°F)	ASTM D-648	175 °F
Flamability: FAA 60s vertical burn & FAA 12s vertical burn	FAR 25.853b	PASS
	FAR 25 (F) (I) (a) (1) (ii)	PASS

NOTE 1: The above information was obtained from ROYALITE R57 specification data sheet.

NOTE 2: For additional information, go to www.spartech.com

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E. KYDEX 6200

Properties of the Material

KYDEX® 6200 is a proprietary, high performance thermoplastic sheet designed for use in mass transit vehicles.

Property	Test Method	Typical Value
Specific Gravity	ASTM D-792	1.40
Tensile Strength	ASTM D-638	41 MPa / 6,000 psi
Flexural Strength	ASTM D-790	63 MPa / 9,200 psi
Flexural Modulus	ASTM D-790	2,413 MPa / 350,000 psi
Notched Izod Impact Resistance @ 23°C (73°F)	ASTM D-256	187 J/m – 3,5 ft-lbs/in
Coefficient of Linear Thermal Expansion	ASTM D-696	7.92 x 10 ⁻⁵ /°C ; 4.4 x 10 ⁻⁵ / °F
Hardness Rockwell	ASTM D-785	98
Heat Deflection (°F)	ASTM D-648	77.8 °C – 172 °F
Flammability: 2 Independent Laboratory Testing	UL Standard 94	V-0
Federal Aviation Administration	FAR 25.853 (a)	PASS

NOTE 1: The above information was obtained from Kydex 6200 specification data sheet.

NOTE 2: For additional information, go to www.kydex.com

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F. LEXAN 9604 SHEET

Properties of the Material

Lexan* 9604 sheet

Specifically developed for aircraft interior and flame-retardant applications. It is formulated to meet FAR 25.853 A, B and BMS8-251. Available in gauges .060" through .125"

Property	Test Method	Typical Value
Density	ISO 1183	1.20 g/cm ³
Tensile Strength, yield	ISO 527	60 MPa
Tensile Strength, break	ISO 527	70 Mpa
Tensile modulus	ISO 527	2350 Mpa
Tensile elongation, break	ISO 527	120 %
Flexural strength, yield	ISO 178	90 Mpa
Flexural Modulus	ISO 178	2300 MPa
Izod notched impact, 23°C	ISO 180/1A	65 kJ/m ²
Gardner Impact, 20°C	ASTM D3029	>40 J
Coefficient of Thermal Expansion	ASTM D696	7x10 ⁻⁵ X 1/°C
UL Flammability	UL94	V0 (1.47) mm
FAA Flammability	FAR 25.853 A, B BMS8-251	

NOTE 1: The above information was obtained from Lexan specification data sheet.

NOTE 2: For additional information, go to www.sabic-ip.com

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2. Layout

Space reserved to facility layout

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Forms

1. Form Therm-01: Identification of products

Filling Instructions

- A. This form is used by maintenance personnel to control and identify the part which is being thermoformed.
- B. Detailed instructions to fill out this form are indicated below; each number corresponds to the number shown on the form.

1. **OMA:** Write certify number organization maintenance approval - EASA
2. **WO:** Work Order Number.
3. **Batch:** Write the Batch of the thermoformed product.
4. **Date MFG:** DD-MM-YYYY; Date when this activity is performed.
5. **P/N:** Write the Part Number of the thermoformed product.
6. **OEM P/N:** Write the Original Manufacturer's part number.
7. **Desc:** Write the thermoformed product description.

OMA CERTIFY NUMBER	
WO:	P/N:
Batch:	OEM P/N:
Date MFG:	Desc:

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2. Form Therm-02: Non-conformity Product Control

Filling Instructions

- A. In the MATERIAL column, the Sheet box must be checked when the base material or product does not satisfy the physical and documental specifications.
- The material must be done prior to start the thermoforming procedure.
 - The Products must be done after to end the thermoforming procedure.
- B. In the REASON column, the Incoming box must be checked when the sheet has been received in the shop from the stockroom, and the thermoforming box must be checked when the thermoformed product is rejected.
- C. In the REJECTED BY column, name of the person authorized to reject the material or the final product.

DATE	MATERIAL	QTY	P/N	WORK ORDER	REASON	REJECTED BY
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	
	Sheet ☐ Product ☐				Incoming ☐ Thermoforming ☐	

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3. Form Therm-03: Thermoformed Products Control

The purpose of this form is to control the final installation of the thermoformed products, by this reason; this form must be fulfilled by each one of the Part Numbers approved for being fabricated.

Filling Instructions

A. In the batch Number column, the technician must record the specific number of lots assigned in accordance with the following criteria:

- The Lot number code must begin in the 0001 number (for all Part Numbers) and must continue in a progressive manner within the specific P/N. For example, for the third group of thermoformed parts, the technician must assign the Lot Number 0003.

B. In the quantity column the technician must write the number of parts thermoformed within the lot assigned.

C. In the DISPOSITION column is necessary to mark a box to determine the final disposition of the thermoformed product. If the part will be installed in a seat or A/C, check installed box, and then in INSTALLED-ON column is necessary to fulfil the P/N of Seat or Registration number of A/C and S/N in which will be installed if the product is installed by workshop staff.

If you check stock room box in the DISPOSITION column, it is not necessary fulfil the INSTALLED-ON column data. The trace of this part will be done by means of the work order associated with the route tag attached in the stockroom.

D. In the APROVED BY column, only the Inspector will be the person authorized to approve the final product.

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DESCRIPTION	
P/N	

DATE	LOT NUMBER	QTY	WORK ORDER	DISPOSITION	INSTALLED ON	APPROVED BY
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	
				Installed Seat ☐ Installed A/C ☐ Stock Room ☐	P/N _____ S/N _____	

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4. Form Therm-04: Thermoformed Products Control

The purpose of this form is to control the step-by-step procedures of the fabricated products, by this reason; this form must be fulfilled by each one or lots of the Parts Numbers approved for being fabricated.

Filling Instructions

A. This form is used by maintenance personnel to control step-by-step the thermoforming process in the shop.

1. **WORK ORDER:** Work Order number.
2. **DATE:** DD/MM/YY: Date when this activity is performed.
3. **PART NUMBER:** Write the Part Number of the thermoformed product.
4. **DWG PRODUCT and Rev.:** Write the Drawing Number and Revised of the thermoformed product.
5. **LOT:** Write the Lot Number of the thermoformed product.
6. **QTY:** Write the quantity of the thermoformed products.
7. **MOLD PART NUMBER:** Write the Part Number of the Mold.
8. **RAW MAT. PN:** Write the Sheet material part number.
9. **MAT. LOT:** Write the Lot of the sheet material.
10. **SIGNATURE TECHN:** Signature and license of the technician who performs this activity, filling in by hand is obligatory.
11. **DATE:** DD/MM/YY: Date when this activity is performed.
12. **HEATING TIME:** Record the heating time of the material.
13. **FORMING TIME:** Record the forming time of the product
14. **COOLING TIME:** Record the cooling time of the product
15. **FORMING TEMPERATURE:** Record the final forming temperature.
16. **FORMING VACUUM:** Write the Part Number of the material.
17. **PASS OR FAIL:** Mark with "x" one column if the tests pass or fail.
18. **TOOLS AND EQUIPMENT:** Record the information about the calibration tools used.

REMARKS: Enter a brief description of work accomplished indicating the consecutive steps follow in the thermoforming process, also, the principal causes that generated the fault or damage.

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THERMOFORMING PROCEDURE																																																			
1. GENERAL DESCRIPTION																																																			
Work order:	Date:	Part Number:	N° DWG Product and Rev:	Lot:	Qty:	Raw Mat. PN:	Mat. Lot:																																												
1. STEP BY STEP																																																			
Work order:						Sign Techn		Date																																											
2.1 SET THERMOFORMING MACHINE WARNINGS: BEFORE OPERATE THE THERMOFORMING MACHINE; BE SURE MAINTENANCE HAS BEEN DONE. ALL PEOPLE MUST OBEY THE SAFETY INSTRUCTION - USE THE MSDS FOR EACH MATERIAL.																																																			
2.2 CLEANING 2.2.1 CLEAN THE PLASTIC SHEET USING A CLOTH SOAKED WITH ISOPROPIL ALCOHOL. 2.2.2 RUB WITH A DRY LINT-FREE CLOTH AND LET TO DRY IN AIR.																																																			
2.3 PRE-DRYERS. (FOR POLYCARBONATE MATERIALS) 2.3.1 USE THE HOT-AIR CIRCULATING OVEN AT 125°C ± 3°C. 2.3.2 SELECT THE PRE-DRYERS, AND MARK WITH "X" ONE ROW IN THE TABLE 1.1						<table border="1" style="font-size: 0.8em;"> <thead> <tr> <th>Sheet Thickness (mm)</th> <th>Drying Time (hrs)</th> <th>Mark with "X" one row</th> </tr> </thead> <tbody> <tr><td>0.375</td><td>0.15</td><td></td></tr> <tr><td>0.50</td><td>0.25</td><td></td></tr> <tr><td>0.75</td><td>0.50</td><td></td></tr> <tr><td>1.00</td><td>1.00</td><td></td></tr> <tr><td>1.50</td><td>1.50</td><td></td></tr> <tr><td>2.00</td><td>3.00</td><td></td></tr> <tr><td>3.00</td><td>4.00</td><td></td></tr> <tr><td>4.00</td><td>10.00</td><td></td></tr> <tr><td>5.00</td><td>16.00</td><td></td></tr> <tr><td>6.00</td><td>24.00</td><td></td></tr> <tr><td>8.00</td><td>36.00</td><td></td></tr> <tr><td>9.50</td><td>48.00</td><td></td></tr> <tr><td>12.00</td><td>48.00</td><td></td></tr> </tbody> </table> TABLE 1.1		Sheet Thickness (mm)	Drying Time (hrs)	Mark with "X" one row	0.375	0.15		0.50	0.25		0.75	0.50		1.00	1.00		1.50	1.50		2.00	3.00		3.00	4.00		4.00	10.00		5.00	16.00		6.00	24.00		8.00	36.00		9.50	48.00		12.00	48.00			
Sheet Thickness (mm)	Drying Time (hrs)	Mark with "X" one row																																																	
0.375	0.15																																																		
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6.00	24.00																																																		
8.00	36.00																																																		
9.50	48.00																																																		
12.00	48.00																																																		
2.4 INSTALLATION MOLD AND MATERIAL 2.4.1 INSTALL AND ATTACH THE MOLD IN THE PLATEN. 2.4.2 INSTALL AND ATTACH THE PLASTIC SHEET IN THE CLAMP FRAME OF THE MACHINE.																																																			
2.5 OPERATION MACHINE 2.5.1 REFER TO THE OPERATION MANUAL IN ACCORDANCE WITH THE THERMOFORMING MACHINE.																																																			
2.6 RECORD PROCESS 2.6.1 MONITORING THE PLASTIC SHEET DURING PROCESS AND RECORD: FORMING TIME, HEATING TIME AND COOLING TIME. 2.6.2 USE THE INFRARED THERMOMETER DEVICE AND RECORD THE FORMING TEMPERATURE FINAL. 2.6.3 USE THE VACUUM GAUGE INCORPORATED IN THE MACHINE AND RECORD THE FORMING VACUUM FINAL.																																																			
NOTE a. USE THE MATERIAL DATA SHEET TO DETERMINE THE FORMING TEMPERATURE RANGE. b. DEMOLDING A RIGID PART AT 100°C ± 5°C TO AVOID DEFORMATION. c. IN ORDER TO MANUFACTURING MULTIPLES PRODUCTS, REFER TO PREVIOUS DATA RESULTS and SETUP VALUES IN THE MACHINE																																																			
2.7 CUTOOUT PRODUCT 2.7.1 TRACE THE CUT LINES IN THE PRODUCT. 2.7.2 CUTOOUT THE THERMOFORMING PRODUCT, MAKE SURE THAT THE DIMENSIONS ARE IN ACCORDANCE WITH THE DWG. 2.7.3 USE SANDPAPER No 400 TO REMOVE SHARP-EDGED IN THE PIECE																																																			
2.8 APPROVAL INSPECTION 2.8.1 VERIFY DIMENSIONS WITH DRAWING PRODUCT. 2.8.2 VERIFY FOR VISUAL INSPECTION. Example: THICKNESS, QUALITY FINISH, UNUSUAL DEFORMATION or BLANKED POINTS. 2.8.3 IDENTIFY THE PART USING THE FORM THERM-01. 2.8.4 THIS PART WAS MANUFACTURE IN ACCORDANCE WITH THE PROCEDURE THERMOFORMING OF THERMOPLASTIC SHEET MATERIALS.																																																			
PART NUMBER		DESCRIPTION		SERIAL NUMBER		DUE DATE																																													
2.9 TOOLS AND EQUIPMENT 2.9.1 CALIBRATED TOOLS AND EQUIPMENT USED																																																			
REMARKS																																																			

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5. Form Therm-05: Authorized Products to be Fabricated

The purpose of this form is to control the list of thermoformed products that have been approved by the Engineering Group for final manufacturing.

The maintenance chief will be responsible for maintaining the updated status of the Design Data that were approved by the Engineering Group for manufacturing, and every time that issue a new revision in the Design Data for any product, the maintenance chief must update the approved parts information on this form and will be responsible for keeping it up to date. This ensures that technical staff will only use the up-to-dated Design Data.

Nº	PRODUCT DESCRIPTION	P/N - OEM	LOCAL - P/N	APLICABILITY	PRODUCT DRAWING	MOLD DRAWING	PREPARED BY:	APPROVED BY	DATE
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

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***** END OF PROCEDURE *****

Anexo B

“Foreign Part-145 approvals Fabrication of Parts”,



Foreign Part-145 approvals Fabrication of Parts	Doc # Approval Date	UG.CAO.00131-002 28/02/2019
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Foreign Part-145 approvals - Fabrication of Parts

UG.CAO.00131-002

	Name	Validation	Date
Prepared by:	Marc GRAGNOLI	Validated	27/02/2019
Verified by:	Karl SPECHT	Validated	27/02/20019
Reviewed by:	Dominique PERRON	Validated	27/02/2019
Approved by:	Thaddee Sulocki	Validated	28/02/2019



Foreign Part-145 approvals
Fabrication of PartsDoc # UG.CAO.00131-002
Approval Date 28/02/2019

DOCUMENT CONTROL SHEET

Reference documents

a) Contextual documents

Applicable requirements are listed in the form "FO.CAO.00136-XXX - Foreign Part-145 approvals – Documentation Index".

b) Internal documents

Applicable document are listed in the form "FO.CAO.00136-XXX - Foreign [Part-145](#) approvals – Documentation Index".

Log of issues

Issue	Issue date	Change description
001	31/08/2015	First issue.
002	28/02/2019	• Corporate identity of the Agency changed to European Union Aviation Safety Agency • Endorsement of Commission Regulation (EU) 2018/1142, guidance for parts fabrication in support of the first installation of an STC.





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0. Introduction



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**0.2. Definitions and abbreviations****Abbreviations**

AMC	ACCEPTABLE MEANS OF COMPLIANCE
AMO	APPROVED MAINTENANCE ORGANISATION
AMTO	APPROVED MAINTENANCE TRAINING ORGANISATION
AOG	AIRCRAFT ON GROUND
BIPM	INTERNATIONAL BUREAU OF WEIGHTS AND MEASUREMENTS
CAO	CONTINUING AIRWORTHINESS ORGANISATION
CAP	CORRECTIVE ACTION PLAN
CIPM	INTERNATIONAL COMMITTEE ON WEIGHTS AND MEASUREMENTS
C/S	CERTIFYING STAFF
CC/S	COMPONENT CERTIFYING STAFF
EASA	EUROPEAN UNION AVIATION SAFETY AGENCY
EU	EUROPEAN UNION
GM	GUIDANCE MATERIAL
ILAC	INTERNATIONAL LABORATORY ACCREDITATION COOPERATION
IOSRS	INTERNAL OCCURENCE REPORTING SYSTEM
MOA	MAINTENANCE ORGANISATION APPROVAL
MOAP	MAINTENANCE ORGANISATION APPROVAL PROCEDURES
MOC	MAINTENANCE OVERSIGHT COORDINATOR
MOE	MAINTENANCE ORGANISATION EXPOSITION
MOR	MANDATORY OCCURRENCE REPORTING
MRA	MUTUAL RECOGNITION ARRANGEMENT
NAA	NATIONAL AVIATION AUTHORITY
NRAB	NATIONAL RECOGNISED ACCREDITATION BODY
OEM	ORIGINAL EQUIPMENT MANUFACTURER
PPB	PRINCIPAL PLACE OF BUSINESS
QE	QUALIFIED ENTITY
RAB	REGIONAL ACCREDITATION BODY
S/S	SUPPORT STAFF
STCH	SUPPLEMENTAL TYPE CERTIFICATE HOLDER
TCH	TYPE CERTIFICATE HOLDER
WH	WORKING HOURS
WHOC	WORKING HOURS EASA OVERSIGHT COORDINATOR





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0.3. Scope and applicability.

EASA is the Competent Authority for maintenance organisations having their principal place of business located outside the EU, as established by EASA [Part-145.1](#) “General” and is therefore responsible for the final approval of these maintenance organisations and for establishing procedures detailing how EASA Part-145 applications and approvals are managed.

This user Guide is applicable to EASA Part-145 applicant and EASA Part-145 AMOs’ (hereafter referred as maintenance organisations) having their principal place of business located outside the EU Member States and which are not certified under the provisions of a bilateral agreement signed with the EU.

The provisions of this user guide are complementary to the requirements of Part-145 regulation “as amended” and does not supersede or replace the associated regulatory requirements.

0.4. Purpose

This user guide is intended to provide guidance to maintenance organisations and inspectors on the conditions to obtain agreement by the competent authority to fabricate parts under the EASA Part-145 approval.

0.5. Entry into force

This User Guide comes into force 90 days after publication on the EASA website. Within this time frame the maintenance organisation shall assess the impact of this User Guide revision in the organisation’s procedures and when relevant propose a revision of the affected procedures to the assigned inspector.

The entry into force date of this User Guide does not supersede the need to comply with any other entry into force date(s) established by applicable regulations.

0.6. Associated user guides

EASA has developed associated instructions (user guides, Forms, templates and work instructions), that detail specific matters, which have to be considered as an integral part of this procedure.

A complete listing of these documents, together with their applicability to the maintenance organisations or NAA / QE / EASA, is addressed in the current revision of the “Foreign [Part-145](#) approvals – documentation Index”, [FO.CAO.00136-XXX](#) (XXX identifies the revision number). Documents which are applicable to both NAA/QE/EASA and maintenance organisations are made available on the EASA Web Site (<http://easa.europa.eu>, [Foreign Part-145 Approvals page](#)).

Each time a cross reference is provided to another document or another chapter / paragraph of the same document, this reference is identified with [grey text](#).

0.7. Communication.

All documents and correspondences between the maintenance organisation and EASA including allocated inspectors shall be in the English language unless otherwise agreed by EASA.





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1. Fabrication of parts





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1.0. Definitions

Part-145 [regulation](#) provides the possibility for a maintenance organisations to have the permission to fabricate a restricted range of parts to be used in the course of maintenance within its own facilities.

However, it is not the intent of the EASA Part-145 regulation to provide an alternative mean to manufacture parts outside an approved Part-21 production organisation (POA) and in order to clearly distinguish those activities, the following definitions are adopted:

1.0.1. Fabrication of parts

The term “fabrication” is to be used in the EASA [Part-145](#) environment to identify a restricted production under the limitations of 145.A.42(b)(iii).

1.0.2. Production of parts

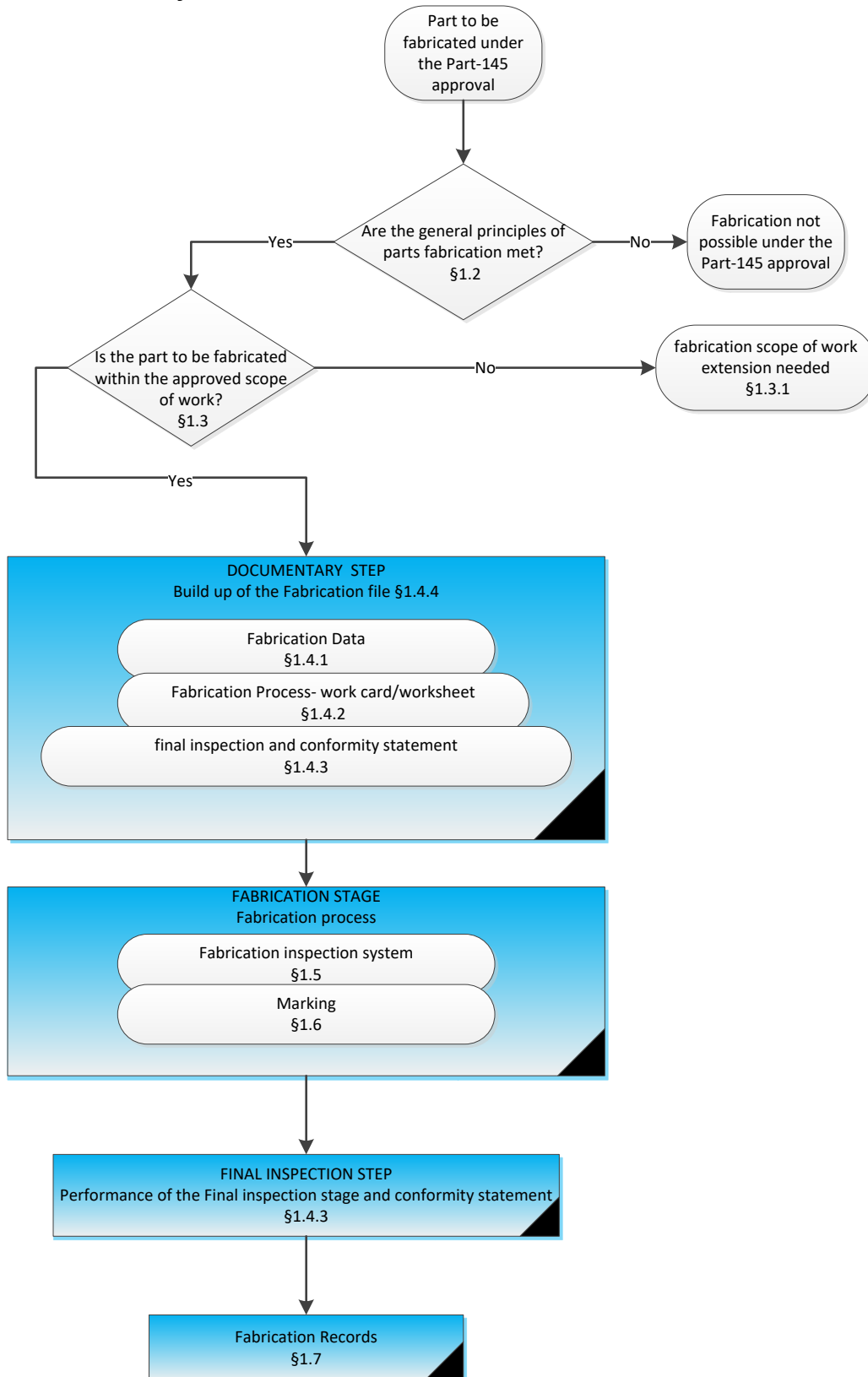
The term “manufacture” is to be used in the EASA Part-21 Subpart G and Subpart F (POA) for mass production.

Note: This user guide is only intended to cover the fabrication of parts by a maintenance organisations and it cannot be used in any way to support manufacturing of parts under the EASA Part-21 regulations.





1.1. Process flow chart





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1.2. General principles for fabrication of parts

When considering fabrication of parts under the EASA Part-145 approval, the following general principles apply:

- the permission to fabricate parts is to be agreed by the competent authority through a detailed MOE procedure (refer to the following chapter “[Scope of fabrication](#)” of this user guide);
- each time the need arise to fabricate a part or a batch of parts, the maintenance organisation shall justify the reason why fabrication of part is used instead of the normal acquisition of an original part. In particular the maintenance organisation shall either provide evidence of:
 - sufficient data to [fabricate](#) the subject part already exists in the current issue of the approved Maintenance data (e.g. the CMM or AMM refers or describes the fabrication process and/or drawings to be used, etc.). Typically this is the case described in [1.4.1 point A and B](#), or;
 - direct authorisation (or no objection) received from the design approval holder to fabricate those specific parts, which shall also include the identification of the fabrication data (e.g. drawing, etc.) to be used. Typically this is the case described in [1.4.1 point C](#);
- the fabrication is to be performed in the course of maintenance. This implies that:
 - items fabricated may be only installed on products and/or components undergoing maintenance at the same maintenance organisation which is fabricating the parts;
 - the item is fabricated under an approved rating (e.g. as part of the maintenance carried out on aircraft under rating A1, engines under rating B1, components under a C rating);
 - the long-term storage of fabricated parts is not permitted. This means they may be only stored for limited time as justified by the duration of the on-going maintenance for which they have been fabricated;
 - the fabrication of parts shall be done within the maintenance organisation’s facilities;
 - the maintenance organisation fabricating the part may subcontract special processes but cannot subcontract¹ the overall fabrication process;
- the parts do not qualify for certification with EASA Form 1. A permission to fabricate does not constitute approval for manufacture, or to supply externally this means that fabrication of parts, modification kits etc., for onward supply and/or sale may not be conducted by a maintenance organisation;
- the fabrication of the following type of parts is not permitted:
 - critical parts (as defined by the design approval holder);
 - complete primary structural elements;
- the fabrication of a part in support of the first installation of an STC (and before the STC is approved), may be done in conformity with design organisation approval holder (DOAH) design data, under their configuration control and in accordance with Part-145. The following shall be considered:
 - the maintenance organisation may work with design data pending approval, with particular emphasis on the configuration control to satisfy conformity requirements (21.A.33) of the test articles;
 - It is up to the DOAH to verify capabilities of the maintenance organisation it intends to work with before starting the STC project. It is recommended that arrangements/interface documents are in place between the organisations involved;
 - after the STC is approved and before the aircraft CRS, the maintenance organisation remains responsible to verify that any part(s) previously fabricated is/are in conformity to the approved data and that this

¹ Subcontracting the entire fabrication of parts as per 145.A.75 (c) may be accepted at the additional condition that the maintenance organisation routinely performs in-house a minimum fabrication within the scope intended to be carried out, to ensure the maintenance organisation maintains the necessary expertise.





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statement is recorded in the maintenance records (refer to paragraph 1.4.3 Final inspection and conformity statement).

1.3. Scope of fabrication of parts

In order to allow the fabrication of parts under the EASA Part-145 approval, the related fabrication, inspection assembly and test should be clearly within the technical and procedural capability of the maintenance organisation. The capability to fabricate parts shall be defined through the MOE content, in particular:

- the MOE chapter 1.9 “Scope of work”, shall specify if the permission of fabrication of parts is included or is not applicable;
- when the permission is included, the MOE chapter 2.9. “Repair procedure” shall further describe the parts fabrication procedure in compliance with this user guide.

For further guidance on the MOE structure refer to the “Foreign Part-145 approvals – use guide for MOE, UG.CAO.00024-xxx)

1.3.1. Identification of fabrication groups

According to the examples given in the Part-145 regulation and guidance material, fabrication under the Part-145 approval can include but is not limited to the following “fabrication groups”:

- (a) Fabrication of bushes, sleeves and shims;
- (b) Fabrication of secondary structural elements;
- (c) Fabrication of control cables;
- (d) Fabrication of flexible and rigid pipes;
- (e) Fabrication of electrical cable looms and assemblies;
- (f) Formed or machined sheet metal panels for repairs;
- (g) Additional cases as agreed by the competent authority².

The “fabrication groups” shall be identified in the MOE 2.9 and limited to the ones for which the maintenance organisation may demonstrate to the competent authority having the effective technical capability.

² The Competent Authority may agree for additional “fabrication groups” to be identified. Elements of a primary structural part (e.g. skin panels, a bracket for a circumferential frame, etc.) could also be considered, but this may depend on how such elements are being considered by the design approval holder in terms of criticality. Any such additional fabrication groups shall be carefully assessed by the maintenance organisation with the involvement when necessary of the design approval holder to support the agreement with the competent authority to allow fabrication. The EASA MOC shall be informed by the assigned inspector when use is made of 1.3.1 (g) option.





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1.4. Fabrication file

1.4.1. Fabrication data

All necessary data to fabricate the part shall be approved either by the Agency or the type certificate (TC) holder or Part-21 design organisation approval holder, or supplemental type certificate (STC) holder.

For the purpose of this user guide any of the following may be considered **acceptable data for fabrication** of parts by the maintenance organisation:

- A. Instructions for continuing airworthiness issued by TCH, STCH or any other organisation required to publish such data by Part 21 (such as ETSO holder). This case typically includes fabrication procedures directly provided in maintenance data such as AMM, SRM, CMM, Overhaul or Repair Manuals, ESM, SB, etc.;
- B. Modification and/or repair data, involving the fabrication of parts, approved under EASA Part-21 regulation or under the terms of a bilateral agreement. This case typically refers to data in support to repairs or modifications which are not already included in available approved data (e.g. structural damages outside the limits of the SRM, etc.);
- C. Manufacturing drawings³ for items specified in aircraft, engines, components parts lists directly provided or made available by a TCH, STCH or an approved production organisation, which is not referred to in other maintenance data (such as AMM, SB, etc.). As already specified in paragraph 1.2, in this case a direct authorisation (or no objection) received from the design approval holder to fabricate those specific parts is necessary, which shall also include the identification of the fabrication data (e.g. drawing, etc.) to be used.

The maintenance organisation shall ensure that the data to fabricate parts is:

- Falling in one of the cases identified above⁴;
- Applicable to the concerned part;
- Up to date, is legally obtained and respect the proprietary data protection; the intent of the regulation is specifically to prevent the maintenance organisations from reverse engineering parts when they do not have legitimate access to the approved design data;
- Including all necessary information of part numbering, dimensions with tolerances, materials, processes, and any special manufacturing techniques, special raw material specification and/or incoming inspection requirement.

³ A particular case may be un-dimensioned drawings such as “loft drawing”. This is basically a full size 1:1 replica of an item that enables the part to be produced to pattern (e.g. some old technology aircraft never had an original dimensioned drawing. In the case of these aircraft, where often multiple compound curves are involved, a “loft drawing” of the item was prepared and was the only means for the production of parts). Such fabrication of parts to pattern may be acceptable provided that an engineering drawing of the item is produced which includes any necessary fabrication processes. However, considering the peculiarity of such case of using un-dimensioned drawings, the maintenance organisation is expected to support the need of manufacturing such parts and to receive the competent authority agreement on a case by case basis.

⁴ TCH messages such as a Non-Technical Objection cannot be considered maintenance data for the purpose of parts fabrication





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1.4.2. **Fabrication process -work card/worksheet system.**

The fabrication of parts process shall be included by the maintenance organisation in the work card/worksheet system (e.g. worksheets, process sheets, engineering instructions, etc.). Work cards/worksheets will be used to convert/split the acceptable data for fabrication into clear stages of work instructions for maintenance personnel. The work card/worksheet system shall be subject to a control procedure which shall:

- Define the responsibilities within the maintenance organisation for developing such instructions in compliance with the acceptable data for fabrication described in the previous chapter;
- Define the traceability of such instructions to each individual fabricated part;
- Ensure that each part undergoing fabrication is unambiguously linked for use on a specific product or component undergoing maintenance in the maintenance organisation. This requires that the product or component where the fabricated part is going to be installed shall be clearly identified in the worksheet/work card (e.g. fabricated for a/c MSN, for Landing Gear s/n ZZZZ, etc.);

For any given part/batch fabrication process, the relevant EASA Part-145 work card/worksheet shall contain:

- The data sufficient to define fabrication such as but not limited to reference(s) of the fabrication maintenance data, required tooling, part numbering, dimensions with tolerances, incoming inspection requirement, raw material specification, detailed fabrication processes, any special manufacturing techniques, marking instructions, intermediate and final inspections, testing, etc.
- Identification of the processes which are subcontracted and related specific inspections by the maintenance organisation.

1.4.3. **Final inspection and conformity statement**

The work card/worksheet shall describe the final inspection and associated conformity statement.

The final inspection stage is required at the completion of the part fabrication. The final inspection shall be done independently from the fabrication itself. In addition the final inspection shall be done before, separately, and independently from, any inspection required at the installation of the part.

The final inspection shall consist of the following minimum elements:

- Check for compliance to the MOE 2.9 procedure related to the fabrication of parts;
- Check completion of the fabrication file (refer to the following chapter);
- Physical inspection of the part **fabricated**, to confirm the part conforms to the approved data for fabrication⁵.

The results of the final inspection shall be recorded and formalised through a dedicated form (which cannot be an EASA Form 1), or directly inside the work card/worksheet system described in the previous chapter provided it is clearly distinguished from task fabrication stages; The final inspection records shall contain reference to the following statement “**part(s) fabricated as per MOE 2.9**”.

⁵ This means that applicable dimensions or data (critical or relevant for fit, form and function) have to be measured during the final inspection stage and recorded, confirming that the part complies with the approved data for fabrication. A simple check box exercise to declare conformity is not considered acceptable.





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1.4.4. Composition of the fabrication file

In conclusion, to support and record the parts fabrication process, a standard “**fabrication file**” is to be used for each part or batch to be fabricated by the maintenance organisation, being composed by:

- the “*data*” described in 1.4.1;
- the “*Fabrication process -work card/worksheet system*” described in 1.4.2;
- the “*Final inspection* and conformity statement” described in 1.4.3

This “fabrication file” will constitute the maintenance records specified in chapter 1.7 of this user guide;

1.5. Fabrication inspection system

The maintenance organisation shall establish a “**Fabrication Inspection System**” to ensure that all fabrication processes, whether performed by the maintenance organisation or by subcontractors under its control, are carried out strictly in accordance with the specifications provided as part of the approved data for fabrication, ensuring as a minimum:

- availability of personnel with defined qualification criteria, including suitable experience and training, and formally authorised by the maintenance organisation to:
 - undertake the necessary engineering functions to fabricate the part, such as but not limited to developing the data described in chapter 1.4.2 “*Fabrication process -work card/worksheet system*”;
 - sign-off for the accomplishment of the fabrication process related tasks including the final inspection stage. Special attention should be paid to tasks requiring specialised knowledge and skill (e.g. NDT/NDI, welding, etc.);
- a system for the control and authorised amendment of all data provided for the fabrication, inspection and test to ensure that:
 - it is complete and up-to-date at the point of use, readily available to fabrication and inspection personnel, and used when necessary;
 - during execution, all works are accompanied by documentation giving either directly or by means of appropriate references, the description of the works as well as the identification of the personnel in charge of inspection and execution tasks for each of the different work phases;
 - each part is inspected in such a way which identifies the nature of all inspections required and the fabrication stages at which they occur (e.g. fabrication work cards with clear inspection stages, such as dimensional checks, NDT, etc.);
- a system to control the fabrication step(s) which are subcontracted;
- parts in process are inspected for conformity with the approved data for fabrication at points in production where accurate determinations can be made;
- procedures to deal adequately with non-conforming parts identified in the fabrication process. Such parts shall be treated as “unsalvageable” and identified, segregated, disposed to preclude its further use (e.g. mutilation by grinding, burning, etc.);
- the means to achieve adequate configuration control of fabricated parts, to enable the maintenance organisation to make the final determination and identification for conformity and eligibility status;
- incoming materials used in the finished product are properly identified as specified in the approved data for fabrication;





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- Parts in process are fully identified and segregated as being fabricated by the maintenance organisation.

1.6. Marking

Any fabricated part shall be marked according to the instructions provided in the approved data for fabrication, including:

- a part number;
- the maintenance organisation's identity.

The main criteria to establish how and by which means the part shall be marked shall be based on the information available in the approved data (e.g. marking field, possible depth and/or means, actual text or symbols to be used, etc.).

By derogation from the above, in cases where it is impractical to mark the fabricated part without compromising the airworthiness (integrity) of the part or not enough space for the marking information is available due to the size/shape issues, the documentation accompanying the part shall include the information that could not be marked on the part. In this case the use of a label is recommended.

1.6.1. Fabrication part number identification

For standardisation and traceability purposes of parts fabricated by maintenance organisations, the following standard is recommended be used to identify the **"fabrication P/N"**:

- original Part Number (mandatory): part number provided in the approved fabrication data;
- maintenance organisation identification (mandatory): EASA.145.XXXX⁶;
- additional maintenance organisation identification codes (optional): additional digits (number and/or letters) may be added according to criteria specified in the MOE to facilitate the part traceability (e.g. year of fabrication, workshop, location, batch number, etc.);

As a consequence, the **"fabrication P/N"** is identified by the digits: A+B+C.

The following is an explanatory example:

Part number as given in the approved data for fabrication (mandatory)	maintenance organisation Identification (mandatory)	Additional identification (optional)
<i>Example</i>	EASA.145.XXXX	2015JAN
Fabrication P/N = <i>Example</i> EASA.145.XXXX 2015JAN		

Special attention should be given to the fact that any symbol or digit included in a part number identification (e.g. point, comma, dash, etc.) is to be considered integral part of the P/N and difference shall be made between lowercase and capital letters. Therefore, the P/N identification marked on the part shall exactly reflect the P/N stated in the documentation accompanying the part.

1.7. Fabrication records

The fabrication records constitute objective evidence that:

- all the prescribed stages of the fabrication process have been satisfactorily completed;
- compliance with the approved data for fabrication has been achieved;

⁶ "XXXX" to be replaced by the EASA Part-145 approval number of the maintenance organisation fabricating the parts





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- traceability from the part to the approved data is ensured.

Therefore, the maintenance organisation shall implement a system for the completion and retention of records during all stages of fabrication appropriate to the nature of the part and its fabrication processes.

The record retention procedure shall:

- describe the organisation of the archiving system (e.g. location, paper/electronic format, responsibility);
- clarify conditions for access to the information (e.g., by P/N-batch of the fabricated parts, or by identification of the component/engine/aircraft on which the fabricated part is installed);
- Ensure that, when a subcontractor is used according to 145.A.75 (c), the records retention function is not subcontracted and the records are duly retained by the maintenance organisation.

The fabrication records are composed by the documents described in the following paragraphs 1.7.1 and 1.7.2

1.7.1. *Fabrication file record*

The “**fabrication file**” referred in chapter 1.4.4 shall be kept for each part or batch in compliance with records retention time provided in EASA Part-145.A.55 (c). Particular attention shall be made to the fact that the time retention period is not counted from the date of fabrication but the date of release to service of the product or component on which the fabricated part is installed.

1.7.2. *List of parts fabricated*

The maintenance organisation shall have a system (e.g. paper register, database, etc.) allowing a listing of all the parts/batches which have been fabricated by the maintenance organisation together with the information of the product/component on which those parts have been installed. The following minimum information need to be recorded.

Template for list of fabricated parts:

Fabrication group	Part Description	Original P/N	Fabrication P/N ⁷	Approved data for fabrication ⁸

⁷ For the identification of the Fabrication P/N refer to 1.1.6 “Marking”

⁸ Refer to 1.4.1 “Fabrication Data”



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CERTIFICA:

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