The global 737NG fleet is spread across the first and second base check cycles. The fleet age ranges from new to 20 years old. The maintenance patterns and programmes vary with operators' rates if utilisation and FH:FC ratios. The implications of these on the 737NG's long-term base maintenance are explored.

737NG long-term base maintenance assessment

The Next Generation 737 (737NG) entered service in 1997. The NG family was derived from the earlier 737 Classics, so the two families share structural similarities and design characteristics. The 737NG is technologically more advanced than the 737 Classic, using different materials in its build alongside a more modern avionic suite. The 737NG family includes the -600, -700, -800 and -900 series of aircraft, which are all powered by the CFM56-7B engine series. The NG offered a new engine, optional winglets, as well as a 30% increase in fuel capacity over its Classic counterpart. Most importantly, the 737NG was designed to be more maintenance-efficient, so it has fewer mandatory maintenance tasks. Corrosion prevention and control programme (CPCP) inspections are integrated into the structural tasks. The 737NG also allows easier access to complete inspections.

Utilisation

There are about 5,750 passenger-configured 737NGs in service. The average age of the fleet is eight years, although about 950 aircraft are more than 15 years old. The fleet, therefore, is now considered to be maturing. "All kinds of aircraft ages are in service, ranging from brand new, up to 20 years old," adds Stefan Sittart, head of network sales, aircraft base maintenance at Lufthansa Technik. "Most of the world fleet is below 12 years of age, so these aircraft are in the first base maintenance cycle." This first maintenance cycle is generally expected to be a pattern of light checks to monitor an aircraft's initial phase of service. Extensive and deep access-focused tasks are unlikely to arise until the end of this first maintenance cycle, and to steadily increase in frequency as the airframe ages.

These 5,750 NGs have average annual flight hours of 2,593FH. This compares to an average annual flight cycle (FC) utilisation of about 1,300FC. The FH:FC ratio is 1.99:1.00, so operators perform an average of 3.6 sectors per day, each of about two hours with the 737NG.

Considerations

The 737NG's various maintenance check requirements have previously been investigated *(see Assessing the 737NG's base maintenance requirements, page 40, October/November 2013, and 737NG maintenance analysis and budget, page 12, June/July 2010)*. Several changes will have occurred to the aircraft's mandatory maintenance requirements and supporting documents since then, however. Focus on the 737NG's maintenance requirements has inevitably shifted towards what happens at base checks on the 737NG once the aircraft has passed through the first maintenance cycle.

The main document that highlights the 737NG's task requirements is the maintenance planning document (MPD). The MPD regularly undergoes revisions and task interval escalations to reflect the global fleet's performance and age, and as such will have several key changes when compared to the MPD investigated in previous articles. "The latest revision for the 737NG MPD is D626A001, which was issued on the 15th of October 2016," explains Rob Neugebauer, product support director airframe and engineering at AFI KLM E&M."

"Apart from the minor adjustments to the tasks common to every MPD revision, there is one significant change that is worth noting," adds Sittart. "This came in 2012, and relates to about 500 new MPD tasks. These affected the oldest 737NGs that had accumulated high FC. These tasks are referred to as the supplemental structural inspection programme (SSIP). Tasks under the SSIP contribute to an influx of fatigue-related structural inspections, which become effective after a specific threshold of accumulated airframe FC has been reached.

"The SSIP tasks mostly require non-destructive testing (NDT) inspections, targeted to discover fatigue-related defects," continues Sittart. "The initial intervals (known as the threshold), and the repeat intervals, are in the higher ranges of FCs. They call for a lot of additional access and can lead to heavy structural findings." The SSIP begins at 30,000FC, and continues to be implemented at thresholds of up to 56,000FC in the MPD.

The 737NG's MPD is driven by MSG-3 philosophy, and contains a majority of FC-influenced tasks. The 737 Classic, on the other hand, was originally an MSG-2 maintained aircraft. Tasks monitored by FC usage commonly denote a focus on structural integrity, since the

The 737NG fleet now exceeds 5,750 aircraft, the majority of which are -800 series aircraft. The fleet ranges from new up to 20 years old. The oldest in the fleet will more than halfway through their second base check cycle.

frequency of take-off and landing exerts the most stress on the airframe. An original equipment manufacturer (OEM) will want to monitor the effect of high FCs on an airframe, and as such it would be expected that an MPD for a maturing or ageing aircraft would want to stringently monitor condition via FC-driven tasks.

It should also be noted that focus on the FC tasks means that an operator undertaking shorter routes, and therefore accumulating a higher number of daily and annual FCs, will experience a different structural programme to an operator performing sectors longer than two hours. This will affect how an operator structures base check packages into the rest of its maintenance programme.

Recent versions of the MPD also include new documentation for certain task types. "The old content of Section 9 is now in four different documents. These are four groups of special tasks that are some of the tasks listed in the main structural and system programmes of the MPD," explains Peter Cooper, planning manager at Civil Aviation Services Ltd. "The four groups are the D626A001-9-01, -02, -03 and -04. The -01 group is a group of airworthiness limitation tasks (AWLs) that are structural inspections. These are listed in -01 because of a requirement by the material review board. They require special attention because they relate to parts of the aircraft that are constructed of new materials. The -02 group are line-specific AWL tasks from the systems programme. That is they relate to particular aircraft, although there are actually no tasks listed yet. The -03 group is a group of certification maintenance requirement (CMR) tasks. The -04 group are special compliance item (SCI) AWL system programme tasks. These relate to air transport association (ATA) chapter 28, fuel system; and ATA Chapter 47 Nitrogen-generation system.

"AWLs are contained in both the new document and also form part of the MPD," continues Cooper.

CMR-related tasks are independent of the MSG-3 analysis process. According to the MPD, CMRs are developed as part of the aircraft systems safety analysis required for aircraft certification. CMR tasks are designed to identify when system probabilities and failure effects might occur that are outside acceptable ranges.

Key revisions/escalations

There are 53 changes highlighted in D626A001, the latest revision of the MPD. Most of these changes relate to revised interval note(s). For instance, a zonal programme task that requires a general visual inspection (GVI) of the left wing has had its threshold and repeat intervals revised from 90 days or 560FC, to 120 days.

Aside from the documentation changes, task intervals may also be amended by the OEM in MPD revisions. If the task interval is increased, it is generally termed an 'escalation'. Escalations occur as a result of the OEM, maintenance review board (MRB) and working groups reviewing worldwide fleet activity. It is the information received via this activity that influences the requirements set by the MPD throughout its revisions. "In the latest MPD revision, the task interval for the light checks (historically termed as 'A' checks) has been escalated to 1000 FH, and multiples thereof," says Neugebauer. "Some heavier base check tasks, sometimes referred to as 'C' checks, have had their calendar intervals increased from 24 months to 30 or 36 months. Last, the majority of tasks with an eight-year interval have been increased to nine years.

"Overall, however, there are no significant changes, although several operators have applied for escalations on certain structural inspections," adds Neugebauer. "The addition of the 737 MAX in 2017 will reveal any significant improvements made by Boeing."

The 737NG vs Classic

The structural and material revisions mentioned above naturally affect tasks in the 737NG's MPD. "The nose and main landing gears are completely different components for the 737NG compared to the Classic," explains Sandra Everest, estimator at 2Excel Engineering Limited. "Different materials and construction methods are also used in general across the aircraft. Therefore the man hours and tooling requirements for these systems and materials are different. The same goes for all fairings and flaps on the NG; processes and inspections times in tasks relating to these parts and components are thereby affected."

The 737NG's MPD

There are 1,629 tasks listed in document D626A001, the main body of the MPD. These tasks are divided between zonal, structural and system programmes. In the excel version of D626A001, the information given per task includes an MPD item number, an aircraft maintenance manual (AMM) reference for the task, a zone number denoting the area of the airframe the task relates to, and an access panel number where appropriate. Other information includes a threshold interval and a repeat interval for each task. The repeat interval is often the same as the initial threshold interval, although it may be shorter depending on whether the task is focusing on airframe fatigue.

Some tasks may only be relevant to certain series of the 737NG, such as the

The MPD is the main document that highlights the 737NG's maintenance tasks. MPD revisions and interval escalations reflect the fleet's performance and age. The latest revision for the 737NG MPD is D626A001, which was issued on the 15th of October 2016.

-600, -700, -800 and -900. This is specified under the 'applicability' column, and where the task applies to the whole fleet, then 'all' is listed for the task. This is the same for the engine-related tasks.

Last, inspection man-hours (MH) are denoted in the MH column, and a brief task description is provided in the final column for each task. This task description covers the level of inspection required of each task, and where appropriate gives reference to other maintenance documentation, such as the aircraft maintenance manual (AMM), to provide further detail.

It should be noted that *Aircraft Commerce* will list only the MPD inspection MH when analysing tasks and checks. Access and preparation MH per task will not be included, although these will be highlighted when significant to the task. Task MH related to the engine and auxiliary power unit (APU) will also be combined for the purposes of this investigation.

Furthermore, due to the average utilisations listed earlier, this article assumes a 15 year-old 737NG will be well into its second base check cycle. The structure and duration of these cycles will be elaborated later. *Aircraft Commerce* also considers older aircraft to be 'maturing' from a maintenance point of view.

In D626A001, several task types are included within the main zonal, structural and system programmes. "Flight length sensitive (FLS) and CPCP tasks are contained within the structural section, whereas electric wiring interconnectivity system (EWIS) tasks, engine and APU tasks are contained within the systems section of the MPD," says Cooper.

Rotable components

In addition to the main groups of system, structural and zonal tasks, the maintenance of rotable components also has to be considered. Rotables are divided between those that are maintained on a hard-time basis, and those that are maintained on-condition.

"Components that are hard-timed in the 737NG family include gas and oxygen cylinders, batteries, fire extinguishers, actuators, landing gear components, and thrust reverser components," explains Cooper. "The nose and main landing gears, for example, have a set overhaul interval of 10 years."

Rotable components are parts that are serialised, and can be rebuilt or overhauled when required. "There are about 700 part numbers that LHT refers to as 'rotable components' on the 737 NG," says Sittart. "Most of the rotable components are being replaced and sent for restoration in shop on a hard time basis (at specific predefined intervals)."

On-condition components include avionic units and several categories of line replaceable units.

Hard-timed components include the escape slides, and other safety-related equipment. These have a requirement to overhaul and perform hydraulic tests at three- and five-year intervals, before being discarded at 15 years. The smoke hoods on-board have a set interval of 10 years before discarding, while the stabiliser trim actuator requires overhauls every 25,000FH. This would equate to every nine or 10 years given the average utilisations recorded.

There are also oxygen and nitrogen gas bottles, oxygen masks and fire extinguishers.

Structural tasks

There are 761 tasks in the 737NG's structural programme, of which 653 apply to every series and aircraft in the fleet. 382 tasks are the ageing tasks that form the SSIP. These have initial inspection thresholds of 50,000FC and 56,000FC. These will be expanded on later, although as noted earlier, the task information in the MPD at this stage does not include MH.

Another 96 of the 761 structural tasks are the FLS tasks outlined above, for which MH are also not supplied. There are two tasks relating to engine changes and shear pin inspections.

Of the other tasks, initial thresholds commence at 24MO or 4,000FC, WCF. There are no FH-driven tasks in the structural programme. Again, given average rates of utilisation, one can assume that MO/YR parameters will be reached ahead of the FC backstop. There are eight tasks with a threshold of 36MO. Four of these tasks have a secondary backstop of 4,000FC and four tasks have a backstop of 6,600FC. Eight further tasks arise at either 48MO or 9,000FC WCF *(see table, page 50)*.

At six years, the groups of tasks become larger and heavier in terms of access and inspection MH. "The 6YR and 12YR structural inspections are considered to be the heaviest, with a large number of structural tasks included," explains Neugebauer. There are 35 tasks with a 6YR threshold interval. "The 8/9YR and 10YR tasks are also heavy. Some 737NGs are also now approaching the FLS tasks, and they involve structural inspections around the wing root section," continues Neugebauer. "These FLS tasks also drive high access hours due to the removal of sealant in fuel tanks for the inspection of production joints.

"The 8YR inspections are triggered at the fourth base check," adds Neugebauer. "Although these are not as in depth as the 12YR tasks, they are the first significant milestone for the airframe. These inspections also allow operators to install modifications such as the electronic flight bag (EFB). This is seen as a good opportunity cost-wise, because most of the access is already gained for

737NG STRUCTURAL PROGRAMME MPD INSPECTION TASKS

Initial Threshold	Repeat Interval	All airframe tasks	Total MH	Deep access tasks/notes	Light access tasks/notes
24MO/4,000FC	24MO/4,000FC	10	3.64		No MH listed - TBD on each input
36MO/4,000FC	36MO/4,000FC	4	5.40		
36MO/6,600FC	36Mo/6,600FC	4	7.60		
48MO/9,000FC	48MO/9,000FC	8	4.00		
6YR/18,000FC	6YR/18,000FC	29	15.10		
6YR	6YR	6	1.60		
8YR	4YR	4	3.00		
8YR/18,000FC	8YR/18,000FC	8	3.20		
8YR/24,000FC	6YR/18,000FC	5	6.80		
8YR/24,000FC	8YR/24,000FC	1	1.00		
9YR	3YR	2	1.50		
9YR	6YR	1	2.00		
9YR	9YR	4	11.10		
9YR/18,000FC	8YR/18,000FC	8	15.10		
9YR/18,000FC	9YR/18,000FC	10	16.00		
9YR/24,000FC	6YR/18,000FC	1	1.30		
9YR/24,000FC	8YR/24,000FC	2	0.40		
9YR/24,000FC	9YR/24,000FC	1	0.60		
18,000FC	18,000FC	2	TBD		SB related. Elevator tabs & hinge fittings inspections
34,000FC	18,000FC	4	TBD		Cargo door surround structure
10YR	10YR	7	6.50	CPCP task on gear assemblies	
10YR	3YR	2	4.00		
36,000FC	10,000FC	1	TBD		
36,000FC	36,000FC	1	TBD		
10YR/36,000FC	10YR/36,000FC	15	25.50	Fuel tank access required	
12YR	8YR	1	0.10		
12YR	12YR	2	4.30		
12YR/36,000FC	8YR/24,000FC	38	60.30	Cabin interior removal Stabiliser bolt removal Flight control panels	
12YR/36,000FC	10YR/30,000FC	4	1.80	Centre wing box	
20YR	8YR	1	0.40		
20YR/50,000FC	8YR/24,000FC	1	2.00	Flight compartment furnishing removal	
NOTE	NOTE	6	TBD		
NOTE-FLS TASKS	NOTE-FLS TASKS	99	TBD		
ENG CNG	ENG CNG	2	0.60	Engine mount to strut shear pin inspections	

Note: MH in the above table are for inspection only. Access MH additional

the 8YR inspections."

There are 12 tasks with a primary threshold interval of 8YR. Secondary FC backstops for these tasks are 18,000FC and 24,000FC. There are 28 tasks at 9YR and 24 tasks at 10YR. "The YR task groups all focus on certain areas of the airframe," explains Sittart. "The 6YR tasks require a full strip of the cargo compartment, while 8YR tasks need detailed inspections of wet areas. The 10YR tasks focus on inspecting the cockpit and fuel tanks."

There are 40 tasks with a 12YR interval. "12YR tasks require full cabin strips, including access to all wet areas forward and aft the aircraft, so these are deep access tasks that require significant downtime," adds Neugebauer.

The frequency of many of these tasks will increase as the 737NG ages. This means that once an aircraft has passed the threshold interval, and the relevant task has been completed, a new shorter interval will supersede the initial threshold. The structural inspections therefore become more frequent as the 737NG undergoes more wear and tear, and accumulates more FCs. About 65 of these core structural tasks have repeat intervals that are shorter than the initial threshold interval.

All 382 tasks in the supplemental structural inspection programme have a shorter repeat interval than the task's threshold. "In the structural programme, most of the 8YR tasks have a repeat interval of 6YR, while a lot of the 9YR tasks have a repeat interval of 8YR," elaborates Sittart. "Last, most of the 12YR tasks have a repeat interval of 8YR."

Significant tasks that are mentioned in the structural section include the MLG and NLG removal, overhaul and reinstallations. These tasks have a 10YR threshold and repeat interval. "From experience, we typically add in the region of between 200MH and 240MH to an estimate for a workscope that requires this work," says Everest. She adds that operators may also combine the 8YR interior upper and lower lobe inspections, with the inspections that occur at 6YR in the same area. This will of course impact the workscope of the 6YR group of tasks.

Flight length sensitive tasks

There are 99 FLS tasks out of the 761 tasks in the structural programme section. These tasks have 'note' ascribed in the threshold and repeat interval columns, and are then identified as FLS in the detailed description column. Operators and MROs are advised in this column to determine the initial threshold at which to perform these tasks using Section 9 from the PDF version of the MPD document. Boeing then suggests a repeat interval per FLS task, which is in FC or FH.

"The threshold has to be determined by the maintenance provider, because the utilisation of each 737NG will influence how and when FLS tasks apply," says Everest. This utilisation will trigger specific FLS tasks at various thresholds. "The maintenance programme for each aircraft will be determined by consulting the threshold curve within the MPD, which is listed as chart 9.0-41 in the PDF document. A continuing airworthiness maintenance organisation (CAMO) will plan these FLS tasks into check packages." The 99 FLS tasks do not have

MH listed in the MPD version D626A001, and they will affect the structural commitments each operator includes in its base check planning. Threshold intervals vary, but the highest intervals that operators can ascribe to these FLS tasks are 75,000FH and 56,000FC according to these charts.

"FLS tasks will also require the maintenance provider to refer to the damage tolerance rating (DTR) document, to evaluate tooling, task methods and observations," adds Everest. "NDT testing is a common requirement."

Examples of FLS tasks that apply across the 737NG fleet include a special detailed inspection of the wing centre-section upper skin at floor beams and shear ties. The task requires ultrasonic inspection of these areas from front to rear spar, and gives a DTR check form reference to consult in the detailed description column. Floor panel removal is needed to perform the task, so significant access time will be required to perform the FLS task. Boeing recommends a repeat interval of 36,000FC to perform this inspection after the threshold.

Another example of an FLS task is a detailed inspection of the front spar lower chord. Again, the DTR document gives detailed information on performing the task. Boeing gives a repeat interval for this task of 24,000FC.

System tasks

There are 661 tasks listed in the system programme section of the 737NG's MPD. 526 of these tasks apply to all 737NGs in the fleet. Most system-based tasks are FH-driven, although there are also FC and calendar parameters given to some tasks.

System tasks are split into 26 ATA chapter sections covering: standard practices; air conditioning; communications; electrical power; equipment/furnishings; fire protection; flight controls; fuel; hydraulic power; ice and rain protection; recording systems; landing gear; lights; navigation; oxygen; water/waste; inert gas system; doors; windows; powerplant; engine; ignition; exhaust; oil; and starting.

About 100 of these tasks are relatively low in frequency, with thresholds and repeat intervals from 48HR to 2,500-3,000FH. These tasks will typically be performed outside a base check, and so will be incorporated into either line maintenance or a light A check. These tasks have light access, and consist of gear lubrications, APU inspections, and engine borescopes among others.

"It is important to note that for aircraft generating high FC per year, the system tasks offer a FC backstop to some of the significant tasks referred to in the

737NG SYSTEM PROGRAMME MPD INSPECTION TASKS

Initial Threshold	Repeat Interval	All airframe tasks	Total MH	Deep access tasks/notes	Light access tasks/notes
48HR	48HR	2	0.14		
500FH & less	500FH & less	7	3.80		
500FH to 1,600FH	500FH to 1,600FH	16	4.22		
1,000FC & less	1,000FC & less	13	2.25		
1,250FC/8MO	1,250FC/8MO	5	2.05		
1,600AH	1,600AH	1	0.20		APU inspection
1,600FC	1,600FC	4	2.10		Engine borescope
Less than 1YE	Less than 1YE	11	4.10		
2,000FC/12MO	2,000FC/12MO	7	5.30		
15MO to 18MO	15MO to 18MO	3	1.35		
1,800FH to 2,000FH	1,800FH to 2,000FH	5	2.90		
2,400FH to 2,500FH	2,400FH to 2,500FH	11	2.55		
2,500FC/16MO	2,500FC/16MO	2	0.80		
3,000FH to 3,600FH	3,000FH to 3,600FH	11	2.32		
4,000AH	4,000AH	1	0.20		APU fuel filter
4,000FC/2YR/24MO	4,000FC/2YR/24MO	32	10.90		
4,800FC/24MO	4,800FC/24MO	2	1.10		
4,000FH	4,000FH	16	5.45		
24MO	24MO	9	4.15		
5,000FC	5,000FC	6	1.40		
5,500FC/24MO	5,500FC/24MO	5	0.75		
5,000FH/3,000FC	5,000FH/3,000FC	17	9.35		Fan blade removal
6,000FH	6,000FH	27	8.45		
6,500FH to 7,000FH	6,500FH to 7,000FH	5	4.25		
6,600FC/3YR/ 15,000FH	6,600FC/3YR/ 15,000FH	12	12.90		
7,500FH	7,500FH	22	9.60		Various system inspections - minor
8,000FH/3YR	8,000FH/3YR	17	5.70		
8,000FC	8,000FC	3	0.70		
9,000FH	9,000FH	2	0.30		
30MO/9,000FC	30MO/9,000FH	3	0.90		
3YR/36MO/ 12,000FH	3YR/36MO/ 12,000FH	13	7.15		
4YR	4YR	4	2.30		
60MO	60MO	1	4.00		
10,000AH	10,000AH	1	0.50		GVI on APU
10,000FH to 11,000FH	10,000FH to 11,000FH	6	2.80		
12,000FH	12,000FH	26	18.45		
12,500 to 14,000FH	12,500 to 14,000FH	4	1.50		
12,000FC to 15,000FC	12,000FC to 15,000FC	8	3.40		
15,000FH	15,000FH	61	23.51		
16,000FH to 17,000FH	16,000FH to 17,000FH	10	2.80		
6YR/72MO	6YR/72MO	17	14.45		Various - minor
5YR&7YR&8YR&9YR	5YR&7YR&8YR&9YR	8	3.40		
18,000FC/6YR	18,000FC/6YR	24	8.97	EWIS & EZAP	
18,000FC/10YR	18,000FC/10YR	1	8.00	NLG restoration	
18,000FH to 20,000FH	18,000FH to 20,000FH	4	2.60		
19,000AH	19,000AH	1	0.40		
21,000FC/6YR	21,000FC/6YR	1	0.30		
21,000FC/10YR	21,000FC/10YR	2	20.00	MLG restoration	
22,400FH to 24,000FH	22,400FH to 24,000FH	4	5.70		
25,000FH	25,000FH	31	21.35		
25,000FC	25,000FC	7	7.90		
30,000FH	30,000FH	9	13.30		
36,000FC/8YR/12YR	36,000FC/8YR/12YR	16	19.50		
40,000FH&48,000FH	40,000FH&48,000FH	2	1.40		
10YR	10YR	11	34.90	Fuel tank access	
12YR	12YR	9	4.60		Function checks
16YR	16YR	1	0.40		
75,000FC	75,000FC	3	28.00	Discard LLP Ldg gear	
VENREC&LLP&APU	VENREC&LLP&APU	52	25.29	Time limited component checks	
LLP - engine/APU components	LLP - engine/APU components	36	ENG SHOP	Removal for heavy SV	

Base checks have historically been referred to as C checks by operators and maintenance providers. Its interval varies between 24 to 36 months, depending on the set-up and content of the checks. The first three C checks are light, after this the C4 check, which is performed at eight or nine years, and the 10YR and 12YR tasks create heavier varying checks.

structural programme," says Everest. "MLG and NLG removals are a further example of this initiative. While the structural programme advises 10YR, the systems programme provides an alternative interval of 18,000FC for the NLG and 21,000FC for the MLG. This means regional operators with short routes and high daily usage will have to bring these tasks forward."

The main task groups in the system programme section include 22 tasks at 7,500FH *(see table, page 51)*. As will be explained later, this interval is regarded by many operators a base check milestone. About 10MH are ascribed to perform the inspections in these tasks, although once again this number does not take into account access times. Since these tasks relate to relatively light system inspections, however, access is anticipated to be minor. There are also 15 tasks at 8,000FH which will likely be combined with the tasks at 7,500FH.

There are 22 tasks at 12,000FH, and the MPD provides an estimate for inspection times of almost 20MH. Tasks that arise at this interval include a detailed visual inspection (DVI) of lightning protection components for corrosion, and the aft rudder quadrant. There are also cleaning tasks for cabin temperature sensors and ozone converters, and operational checks of the main electric horizontal stabiliser trim cutout switch and standby rudder systems.

A further 51 tasks arise at 15,000FH, with MPD labour estimated at about 25MH. Since 15,000FH is a multiple of 7,500FH, one can assume that this group of tasks may formulate part of the second base check workscope. A further eight tasks have an interval of 16,000FH. Operators may therefore combine these tasks with the items at 15,000FH.

Much like the structural programme, there are also significant tasks that come due at 6YR. These include 11 tasks with an interval of solely 6YR, and 24 tasks with an interval of 18,000FC or 6YR. Given the average utilisation from the worldwide fleet of 1,300FC, one can assume that the average aircraft will reach 6YR before hitting 18,000FC. There are 30 tasks that have an interval of 25,000FH.

Again, several tasks also have an interval of 12YR. These include 14 with an interval of either 36,000FC or 12YR, and eight tasks with a single interval of 12YR. These tasks require the displacement of insulation blankets, and the removal of cabin and flight deck furnishings, and some functional checks.

Remaining task groups with significant numbers of tasks include 44 with vendor recommended (VEN REC) as a parameter. They tasks require various checks, and the restoration of components in accordance with the time restraints placed by the vendor. Operators and maintenance providers therefore have to consult the manuals relating to the components to determine each part's limit, and the appropriate intervals for these tasks. Last, there are 34 tasks for engines and the APU. "Some require engine removal for a heavy shop visit, and the removal of the APU for inspection," explains Everest. "2Excel generally estimates about 60MH for access to remove the engines, and about 20MH for the removal of the APU."

EWIS tasks

EWIS tasks are some of tasks in the systems programme section of D626A001. The requirements establish the basis for the enhanced zonal analysis procedure which may be found in FAA AC 25-27.

"The MSG-3 philosophy behind the 737NG's MPD means that duplicate tasks, where EWIS may get to and clear certain areas, are combined appropriately," explains Everest. "This makes the MPD more efficient than the MSG-2 programme for the 737 Classic. If the EWIS tasks had duplicate tasks in the system and zonal sections in an MSG-2 programme, mechanics would have had to access hard-to-reach areas more than once unnecessarily. MSG-3 prevents that." A clear example of duplicated tasks in the 737 Classic's MPD are the structural tasks that require the removal of galleys. "There's also a calendar-driven CPCP task requiring this," adds Everest, "so if the tasks are not synchronised there is potential to pull the galley out twice in a short space of time, unnecessarily."

One EWIS example is System task 20-415-00 for the inspection of all exposed EWIS in the Flight Compartment which requires control stand, overhead and sidewall panels, glare shield and instrument panels to be removed in the flight deck. The interval is 36,000FC or 12YR. This interval will line up with other inspections in the area, such as the structural section task 53-330-00.

Zonal tasks

There are 213 tasks in the zonal inspection programme section of the 737NG's MPD. These zonal tasks are sub-divided by ATA chapter references. These ATA chapters cover landing gear, doors, fuselage, nacelles, pylons, stabilisers, wings and standard practices.

About 60 of the tasks listed in the zonal programme are enhanced zonal analysis procedure (EZAP) tasks. EZAP tasks are a focal point of the zonal programme within the 737NG's MPD.

EZAP focuses on analysing in-depth ageing airframes. Each 'zone' of the aircraft is analysed and all wiring systems, components and structures

737NG ZONAL PROGRAMME MPD INSPECTION TASKS

Initial Threshold	Repeat Interval	All airframe tasks	Total MH	Deep access tasks/notes	Light access tasks/notes
600FC/100DY	600FC/100DY	1	0.10		Cargo door inspection 700C
1,000FC/100DY	1,000FC/100DY	1	0.10		Cargo door inspection 700C
120DY	120DY	12	1.91		
120DY/745FC	120DY/745FC	2	0.2		Gear & gear door inspections
1,500FC/180DY	1,500FC/180DY	4	0.27		
2,000FC	2,000FC	4	0.24		
2,000FC/240DY	2,000FC/240DY	8	0.95		
4,000FC	4,000FC	2	0.10		
4,000FC/18MO	4,000FC/18MO	5	0.60		Light access for cargo aircraft
4,800FC/24MO	4,800FC/24MO	9	4.14		Vertical fin & horizontal stabiliser
5,500FC/24MO	5,500/24MO	5	1.09		
5,500FC/30MO	5,500/30MO	21	4.83		Many external inspections, minor
6,600FC	6,600FC	2	0.10		
6,600FC/36MO	6,600FC/36MO	80	13.54	L/R wing access	Light access for inspection entire a/c
3YR	3YR	2	0.20		
36MO	36MO	2	0.10		
9,000FC/36MO	9,000FC/36MO	4	0.84		Engine strut fairing panel access
13,200FC/72MO	13,200FC/72MO	5	3.84		Cargo bay panels
18,000FC/6YR	18,000FC/6YR	2	0.34		
18,000FC/8YR	18,000FC/8YR	4	1.20		
18,000FC/9YR	18,000FC/9YR	4	0.50		
21,600FC/6YR	21,600FC/6YR	6	1.50		MLG support beam and wing tip
24,000FC/9YR	24,000FC/9YR	3	1.16	Wing to body fairing access	
36,000FC/8YR	36,000FC/8YR	2	4.00	Wet areas (galleys & lavs removed)	
36,000FC/9YR	36,000FC/8YR	1	1.50	Aft control cabin to fwd entry door inspections	
36,000FC/10YR	36,000FC/10YR	8	9.68	Flight control furnishing & panel removals	
10YR	10YR	2	0.50	Trailing edge of wings	
36,000FC/12YR	36,000FC/12YR	6	6.75	Cargo by panel removals, centre wing box inspection	
Totals		207	60.28		

Note: MH in the above table are for inspection only. Access MH additional

within this zone are identified. If a zone is identified as containing potentially hazardous or combustible materials then a task is developed to prevent a build-up of dust, for instance. These tasks typically include a GVI of the zone and its wiring.

As the 737NG has a core zonal inspection programme, GVIs that cover a zone due to an EZAP task may also meet the requirements of other tasks within the zonal programme.

EZAP tasks first appeared in the 737NG's MPD in 2008. "Given the MSG-3 logic applied to this MPD, however, many EZAP tasks within the zonal programme are interlinked with the core zonal programme, so some EZAP tasks are met by the completion of other zonal tasks," explains Everest. "Item 54-806-01 in this section is an example. It relates to an internal zonal GVI of the aft strut fairing. There is a note for this task that states an EZAP inspection task due at 12,000FC or four years, whichever comes first (WCF), is satisfied by this task." EZAP procedures are therefore difficult to plan trade-related MH for, since they can often require multi-licence type coverage.

Most zonal tasks are FC-driven. 194 tasks apply to every aircraft in the fleet, rather than certain series. Of the 213 tasks, 187 have FC as the primary threshold. The rest have a calendar threshold in days (DY), months (MO) or YR.

183 of these FC-driven tasks have a calendar backstop as a secondary threshold. This means that an operator's utilisation will affect the structure of the zonal programme. For example, there are tasks with a 36,000FC threshold that have either 8YR or 12YR calendar thresholds (WCF). These zonal tasks relate to aft passenger compartment inspections, and require the removal of galleys and toilets. Given the average utilisation of 1,300FC for the worldwide fleet, one can assume that in eight or 12 years the average 737NG will have accumulated 10,500-15,600FC. These two groups of tasks would therefore occur at about 8YR and 12YR, depending on the calendar threshold specific to the task.

According to Lufthansa Technik, the collection of tasks that arise at 8YR and 12YR in the zonal programme represents significant task groups. These have high initial thresholds and come into effect as the aircraft ages.

Groups of tasks that require significant access and inspection efforts include a set of 80 tasks that arise at 6,600FC or 36MO, WCF. These tasks require deep access and special detailed inspections of the left and right wings, alongside light access requirements for inspections over the entire aircraft. About 12MH are allocated just to carry out the inspections *(see table, this page)*.

There are also three tasks at 24,000FC or 8YR WCF that require wing-to-body fairing access. This is in addition to the 8YR group of tasks mentioned previously. There is also a single task at either 36,000FC or 9YR that requires special detailed inspection aft of cabin to the forward entry door, which also necessitates the removal of galley and toilets. It is therefore likely that this would be grouped in with the 8YR tasks that require the same deep access.

There are eight tasks at 36,000FC or 10YR WCF relating to inspection of the flight control compartment that needs the removal of furnishing and panels. These tasks also relate to fuel tank inspections, so fuel and surge tank access is required. The MPD advises at least 10MH to carry out these inspections, minus the time to access these areas. The remaining task groups with significant inspection and access MH include two tasks at 10YR, which require detailed inspection of the trailing edge of each wing, and six tasks at 36,000FC or 12YR WCF that focus on centre wing box inspections, internal cabin inspections and an assessment of the vertical fin.

14 of the zonal tasks have a threshold of 120 DY. Two of these have a secondary threshold of 745FC. These tasks consist of GVIs of the NLG, MLG and landing gear doors, wings, aft cargo compartments, powerplants and the vertical fin and horizontal stabilisers. As these are GVIs, MH for these tasks are low, and panel access requirements are also minimal. These tasks are likely to be treated as line maintenance tasks, or performed during a light or A check.

Ageing tasks

As described, the 50,000FC and 56,000FC SSIP tasks, and FLS tasks shape the MPD for ageing aircraft. "Most of the tasks at 50,000FC have short repeat intervals," continues Everest. "It remains to be seen whether these will be revised, since the performance of the ageing fleet will determine the required length of the repeat intervals." Given the annual utilisation of 1,300FC used, one can assume that, on average, these tasks thresholds would not arise until most aircraft are more than 30 years old.

As previously explained, no task MH are ascribed to the 50,000FC, 56,000FC and 'note' or FLS tasks. It is difficult for maintenance providers to provide an MH or cost estimate for these tasks, when planning a workshop for a shop visit. "As an estimator, one sees the 'D' number ascribed to one of these high FH or FC tasks," explains Everest. "This refers to the 'Damage Tolerance Rating' (DTR) document in the MPD. From this, an estimator can discern what is required from the task.

"The DTR will provide a detailed drawing and cross-sectional analysis of the task, and what level of access and inspection is required," adds Everest. "The estimator will then liaise with various departments to gather, from experience, labour estimates to perform the necessary inspections. The NDT department, for example, will know roughly how many MH are required for an NDT of the upper and lower skin stringers. From experience, 2Excel Engineering knows that it takes in the region of 50MH of access time for wing access inspection tasks, for instance."

There are 252 tasks with a threshold of 50,000FC. These tasks have varying repeat intervals, all of which are shorter than the threshold. The 50,000FC tasks are mainly a mix of GVI and special detailed inspections, whose requirements change per task between ultrasonic inspections, and low/high frequency eddy current inspections. Window frames, doors, door frames, fasteners, stringers, and bulkheads are just some of the areas being assessed during these 50,000FC interval inspections.

A further 215 tasks arise at 56,000FC. While these tasks require the same level of detailed inspection, they focus on wing attachments, spars and spar chords, engine mounts, and the wing centre sections.

2Excel has recently estimated that the 56,000FC tasks relating to wing and centre tank sections will take in the region of 800MH. A maintenance provider aiming to perform these tasks must also consider the tooling investments. The tooling required for the wing and centre tank inspections, for example, cost in excess of $25,000. "There is also a two-week lead time to acquire the tools," says Everest. "An MRO that acquires the tooling can rent it out post-inspection to other providers that want to perform the high-threshold tasks." An example of this tooling is test blocks used to calibrate, specific only to the high-utilisation tasks. An MRO has no option but to rent or buy these so that they can perform the ageing tasks seen in the supplemental structural inspection programme.

"The difference with these tasks is that they aim to explore more than what is visible to the mechanic," continues Everest. "While an MRO historically accessed areas to determine the condition

737NG SUPPLEMENTAL STRUCTURAL INSPECTION PROGRAMME MPD

Initial Threshold	Repeat Interval	All airframe tasks	Deep access tasks/notes
50,000FC	4,000FC	33	
50,000FC	6,000FC	6	
50,000FC	8,000FC	2	
50,000FC	9,000FC	25	
50,000FC	12,000FC	4	
50,000FC	14,000FC	1	Internal detailed and NDT
50,000FC	15,000FC	2	(HEFC, LEFC & ultrasonic)
50,000FC	16,000FC	1	Inspections down to A/C
50,000FC	17,000FC	1	structural level with reference
50,000FC	18,000FC	47	to DTR documents
50,000FC	22,000FC	4	
50,000FC	24,000FC	43	MH not currently shown in MPD
50,000FC	30,000FC	1	
50,000FC	33,000FC	1	
50,000FC	36,000FC	80	
50,000FC	40,000FC	1	
56,000FC	1,600FC	1	
56,000FC	2,000FC	5	
56,000FC	3,000FC	1	
56,000FC	3,500FC	1	
56,000FC	3,550FC	4	
56,000FC	4,000FC	9	
56,000FC	5,000FC	1	Additional to the notes for 50,000FC
56,000FC	6,000FC	11	deep access requirements for
56,000FC	8,000FC	1	example sealant & structural parts
56,000FC	9,000FC	25	removals needed for inspection
56,000FC	10,000FC	1	
56,000FC	11,000FC	1	
56,000FC	11,600FC	1	
56,000FC	12,000FC	5	
56,000FC	13,000FC	1	
56,000FC	14,000FC	2	
56,000FC	15,000FC	8	
56,000FC	18,000FC	70	
56,000FC	21,000FC	4	
56,000FC	22,600FC	1	
56,000FC	24,000FC	17	
56,000FC	27,000FC	1	
56,000FC	28,000FC	1	
56,000FC	30,000FC	1	
56,000FC	34,000FC	1	
56,000FC	36,000FC	39	
56,000FC	75,000FC	2	

There are 99 FLS tasks in the structural programme section. Operators and MROs are to determine the initial threshold at which to perform these tasks using Section 9 from the PDF version of the MPD document. The utilisation of each 737NG will influence how and when FLS tasks apply, as it will trigger specific FLS tasks at various thresholds. Some tasks will require deep access.

via a GVI, or an NDT, the ageing tasks aim to go beyond more than what is visible. Therefore these tasks may require sealant removals, for example, which is a step further than the requirements of the core MPD tasks." More preparation and deeper access is required for these high-threshold tasks, which will significantly affect downtime during inspections.

Furthermore, the availability of NDT equipment and staff might be an issue for MROs, when the high FC tasks begin to take effect across the 737NG fleets. "Some customers may also wish to clear these tasks early, particularly in leased aircraft," adds Everest. "MROs will have to prepare accordingly, because downtime could be dictated by availability of NDT technicians, rather than the performance of the tasks themselves."

Some 12-year-old 737NGs have been scrapped for parts. "These may potentially be feeding the spares market, to provide options for operators and lessors when maintaining the ageing aircraft," explains Cooper. "Lessors may scrap to supply the rest of their 737NG fleet with a source of spares and green time parts, for example. Other lessors are selling aircraft with FHs in the high 40s."

It is common for OEMs to include a sampling programme in the MPD, to target and assess the characteristics of an aircraft type as it accumulates FH and FC. These sampling tasks generally take affect during the third, maturing base check cycle. LHT explains that there is no sampling programme for the 737NG, although the SSIP is obviously designed to focus on the same developments of an ageing airframe.

The point at which the ageing tasks come due will, again, depend on the aircraft's utilisation. Industry figures show that a 737NG may be completing as many as 8FC a day, probably for sectors of as little as 30 minutes. This might mean that the high FC tasks would come due when the aircraft is a little over 20 years old, towards the end of the second base check cycle. This may be almost 20 years before aircraft operating at 'normal' rates of utilisation in Europe, for example.

737NG check inputs

As earlier described, the 7,500FH or 2YR interval is a popular interval at which to perform a base check. The base check consists of deep access, excessive downtime tasks such as detailed inspections and component removals and overhaul. Operators will therefore group these tasks rather than perform them individually as and when they arise.

There are other, lighter tasks that have been outlined throughout the zonal, structural and system programmes. The access for these tasks is relatively minor in comparison to those performed during the base checks. Some operators will still group these into 'light checks' to clear periods to operate efficiently. "The cycle of these checks is highly dependent on the operation," explains Neugebauer. "This goes from no cycle at all, for instance performing all tasks on an OOP basis, to a complete A check cycle adapted to operator and MRO requirements. This differs highly between operators due to different types of operation."

Light checks

The lighter tasks outlined throughout the zonal, structural and system programmes will likely become part of the light check packages for the 737NG. "In general, the A check interval is about the 1,000 FH, between 90DY and 120 DY and 600FC to 700FC WCF," says Neugebauer. "Typically operators conduct A checks every three months, with average utilisation at about 2,500FH and 2,000FC per year." This is a utilisation that is slightly lower than the averages outlined of the global fleet. This may lead an operator to stage light checks at slightly longer intervals, perhaps every 120DY as opposed to 90DY.

"We perform an A check every 90 days," says Sittart. "Typically eight A checks are performed in one base check interval, but this entirely depends on the airline's fleet management concept.

"These light checks are differently named by operators. Some call them phases, others Q checks (Quarterly Checks) and some still refer to them as A checks," continues Sittart.

Base check events

Base checks have historically been referred to as C checks by operators and maintenance providers. The interval varies from 24 to 36 months for the 737NG, depending on the set-up and content of the checks. "We perform the KLM 737 C checks at 2-and-a-half year intervals," outlines Neugebauer. "The 6YR, 9YR and12YR structural inspections are significant milestones for this type of check.

"The first three C checks are light (C1-C3)," continues Neugebauer. "After this the C4 check, which is performed at eight or nine years, and the 10YR and 12YR tasks create heavier varying checks. In general, the FH interval for the C checks are from 6,000 FH to 8,000 FH, while the FC interval is 3,000-5,500FC."

Base check intervals are not clearly defined within the 737NG's MPD, because there are out-of-phase (OOP) tasks that do not fit neatly into a base check package. Operators will often bring OOP tasks forward to the base check before the OOP task to clear the aircraft for operation.

2Excel Engineering Limited performing an end-of-lease handover, C check and AD related maintenance on a 737NG. A crack was found on one of the flight deck window planes during a check, which needed to be replaced.

"The planning of OOP work is influenced by a number of factors," says Neugebauer. "If the OOP work is deemed too extensive for an A check input then a concession will be requested from the manufacturer, such as a temporary repair with the commitment to final repair at the next C check. The main driver for a critical path during a maintenance input will often be an OOP task, such as a mandatory airworthiness directive (AD).

"The most common interval in the systems section of the MPD is 15,000FH, while in the structural element it is 50,000FC," adds Neugebauer. "The MPD is calculated around blocked maintenance, and the MPD intervals are targeted at a utilisation of 8FH per day and 5.5FC per day, so with this in mind there is not a standout base check interval." A widely used approach, however, is to combine base checks with structural tasks, so that operators can incorporate upper and lower lobe checks, and MLG and NLG removals with the base checks. "It is not unusual for 737NGs halfway through a second base check cycle to undergo 6YR, 8YR, and 10YR structural tasks at the same time to clear the aircraft of heavy maintenance for a few years," highlights Everest.

The base check cycle is broadly considered to be 12 years. It therefore comprises six base checks, the C1 to C6 checks, and a total interval of about 30,000FH and 16,000FC based on the actual utilisations described *(see table, page 58)*. "Once the first base check cycle has been completed, the 'C' check cycle is technically restarted," explains Everest. "The higher FH and FC tasks kick in with more effect, however, during the second base check cycle. The second base check cycle should begin at 16,000-18,000FC for the average operator."

Experienced MRO providers such as 2Excel often apply block access and inspection MH for 6YR, 8YR, 10YR and 12YR tasks, and base checks, explains Everest *(see table, page 58)*. These MH are derived by an MRO's experience of performing the tasks.

Grouping tasks

Aircraft Commerce has outlined an example of base check packages for the 737NG *(see table, page 58)*. The table illustrates three base check cycles of C1 to C6 checks, C7 to C12 checks, and C13 to C18 checks. This therefore takes an aircraft operating at average rates of utilisation to the supplemental structural programme of 50,000FC tasks by the C18 check. The assumptions used for these check packages include:

- Aircraft utilisation of 2,593FH/1,300FC per year, meaning calendar backstops will likely arise before FC intervals.
- MH for the third base check cycle do not include those for 50,000FC, 56,000FC and FLS tasks.
- Inspection MH are for all tasks – not just those with applicability 'All'.
- The following tasks are grouped together:
- 5,000FC & 6,600FC
- 10,000FH & 11,000FH
- 12,000FH, 22,400FH & 22,500FH
- 24,000FH & 25,000FH

Tasks arising in years between base checks have been brought forward into the base check preceding the task(s).

The groupings displayed in this table should be treated purely as a case study, to show how checks may be structured. Work packs will vary by airframe, according to each operator's practices.

Reality factor

When providing estimates for its customers, a maintenance provider such as 2Excel will aim to provide as realistic an illustration of downtime and actual route labour MH requirements as possible. Everest explains that this is often referred to as a 'reality factor'. 2Excel often uses a factor of about 2 on MPD inspection task MH to accurately reflect the actual labour MH used to perform the inspections listed in the 737NG's MPD, for example.

There are some tasks where a reality factor is not applied. "These are the 'special access' tasks, which refer to the required access of a function or system on board" says Everest. There are 76 special access numbers on the 737NG. These tasks are highlighted via the 'access' column in the PDF version of the MPD.

Once the reality factor and access MH have been applied, the estimated routine labour for the six checks in the cycle will be 439MH to 2,265MH *(see table, page 58)*.

Non-routine ratios

Maintenance providers use a non-routine (N-R) ratio to account for the event of unpredicted findings. As a rule, N-Rs for the 737NG go through incremental increases depending on the aircraft's stage in its base check cycle, and its age. "The N-Rs that we apply depend on the climate the aircraft operates in, its ownership history, and operating habits (for example its FH:FC ratio), as well as age," describes Everest. "The proximity to the last base check carried out will also affect the N-R applied, so maintenance providers will take into account when the last C check was done. If the aircraft recently had the extensive 12YR/sixth base check done, the N-R may be as little as 50-60%."

Ageing aircraft such as those in the 15-20-year-old group may experience N-R ratios of 80% operating under 'normal' FH:FC ratios. These can vary from 75% to 110% however, depending on the above operating habits and parameters *(see table, page 58)*.

SUMMARY OF MH & MATERIAL INPUTS FOR TWO BASE CHECK CYCLES - PASSENGER CONFIGURED 737NG

C CHECK	YEAR	INTERVAL (MPD)	ACTUAL FH	ACTUAL FC	MPD MH	ACTUAL MH	ACCESS MH	ROUTINE MH	N-R RATIO	SUB-TOT MH	C CHECK+ A CHECK MH	MATERIALS $
C1	2	7,500	5,186	2,600	43	110	241	439	15%	505	686	17,144
C2	4	15,000	10,372	5,200	72	185	335	540	25%	675	860	21,496
C3	6	22,500	15,558	7,800	144	370	520	918	35%	1,240	1,519	37,980
C4	8	30,000	20,744	10,400	82	211	820	1,383	45%	2,005	2,756	68,905
C5	10	37,500	25,930	13,000	173	445	765	1,307	55%	2,025	2,427	60,685
C6	12	45,000	31,116	15,600	229	589	1,651	2,265	100%	4,531	5,068	126,711
C7	14	52,500	36,302	18,200	68	175	241	549	55%	851	1,137	28,431
C8	16	60,000	41,488	20,800	75	190	335	620	65%	1,023	1,340	33,499
C9	18	67,500	46,674	23,400	174	447	520	1,121	75%	1,961	2,471	61,763
C10	20	75,000	51,860	26,000	255	653	820	1,654	80%	2,978	3,544	88,601
C11	22	82,500	57,046	28,600	56	143	765	1,050	85%	1,942	2,454	61,351
C12	24	90,000	62,232	31,200	228	586	1,851	2,484	120%	5,464	6,044	151,091
C13	26	97,500	67,418	33,800	56	144	291	755	75%	1,321		
C14	28	105,000	72,604	36,400	128	328	385	912	80%	1,642		
C15	30	112,500	77,790	39,000	290	745	570	1,341	85%	2,481		
C16	32	120,000	82,976	41,600	68	174	920	1,261	100%	2,522		
C17	34	127,500	88,162	44,200	78	200	785	1,123	110%	2,357		
C18	36	135,000	93,348	46,800	310	795	1,951	2,745	150%	6,863		

Once non-routine labour has been applied, as well as the due A check tasks, the sub-total for each check will be 686MH for the C1, and will increase to 5,068MH for the C6 check. This will rise to more than 6,000MH for the C12 check. A budget of materials, consumables and expendables at a rate of $25 per MH. This results in a low rate of expenditure at about $17,00 for the C1 check, and increases up to $127,000 for the C6 check *(see table, this page)*.

These labour and material inputs only represent routine inspections and related non-routine defect rectifications. Additional items for the check will include ADs and SBs, modifications, cleaning, interior refurbishment, and heavy component changes. These elements will about another 2,500MH for the heavy checks at the end of the cycle, as well as additional material costs and expenditure for interior refurbishment items.

Cosmetic work

According to Everest, the heavy structural tasks that occur during the C4 base check often provide operators a convenient opportunity to perform refurbishments, due to the deep access requirements of the tasks. These refurbishments could also occur during the 6YR tasks, especially if the 8YR tasks have been bought forward to 6YR. AFI KLM E&M explains that galleys, toilets, passenger service units (PSUs), overhead bins, ceiling /wall panels, and carpets and seats are refurbished rather than replaced.

"Depending on the operator, typically aircraft on lease for budget airlines have the least amount of cabin refurbishment," says Neugebauer. "Flag carriers and private customers will require the highest qualities of cabin finish on all inputs. A high number of these items can normally be repaired rather than replaced."

In terms of stripping and repainting a 737NG airframe, operators often elect to refresh the paint on the fuselage, fin and engines. This is often carried out during a lease handover, because operator logos and livery will need to be changed. If the areas are rubbed down ('abraded') then this cost may be in the region of $60,000. If a full strip and removal of paint is carried out before recoating, it will cost-$70,000-$85,000.

Summary

The structure, format and complexity of the 737NG could not be more different to its Airbus counterpart, the A320, despite the two aircraft sharing the same MSG-3 philosophy. "While both are indeed MSG-3, the way that tasks are presented is very different," says Everest. Rather than differentiate task applicability by the type, for example, the A320 also differentiates also by modification. If you look at the applicability/effectivity columns for the A320 compared to the 737NG, you can see that modification and line numbers are the main parameters defining those that the task is appropriate for. This is more complex than the NG, which is differentiated simply by series in these columns.

"Based on the A320's approach, you might have a long list of tasks that initially look applicable to your fleet, but on closer inspection may only apply to a single aircraft due to its configuration and modification status," summarises Everest.

The general attitude towards the 737NG is that there will be a massive shift in the focus of its MPD within the next five years in order to direct the tasks to acknowledge the maturing fleet. Based on this, one can assume that MH will begin to populate the ageing tasks, and maintenance providers will contribute experience to the actual implications behind the supplemental structural programme. These findings, based on historical data, will truly determine the ageing MPD going forward.

Last, and importantly, it seems that lessors are beginning to question the viability of carrying out the high FC tasks. In recent years for instance, aircraft registries, including in Turkey, China and India, have begun to tighten regulation surrounding aircraft registration. The Turkish registry has stipulated that aircraft not older than 15 years can enter its register. However, once an aircraft is registered it can stay on indefinitely. The implications of these regulations for local carriers cannot be ignored. AC