There are seven categories of materials used in airframe maintenance. The are also many variables that affect their rate of consumption. The consumption of labour and related cost of materials used in two base cycles for the A340-300 are examined.

Budgeting for the cost of materials & parts in widebody base checks

Estimating and budgeting for the cost of materials for widebody base checks, and their use in overall airframe maintenance, is less exact than for man-hour (MH) inputs. Many variables affect the final cost, and there is often little correlation between this cost and labour inputs for many elements of an airframe check.

Materials definitions

There are many categories of materials, and different classes are used for different types of maintenance tasks and inspections, and non-routine rectifications and repairs.

The first category is consumables: non-aircraft parts: cleaning fluids; sealants; greases; oils; corrosion treatment liquids; paint; rags; sandpaper; cleaning papers; and tissues.

The second category is expendables, cheap aircraft parts that are discarded after they break or fail because it is not economic to repair them: nuts; bolts; rivets; washers; o-rings; filters; screws; simple wiring and electrical parts; clamps; fasteners; brackets; and other small items that are bought in bulk. More complex expendables include: lightbulbs; batteries; valves; switches; electrical components; hinges; regulators; tubes; and pipes.

The third category is repairable parts and components, such as carbon brake discs, tyres that can be remoulded, panels and skins. The fourth is rotables. Both repairables and rotables are repaired after failure or problems. Repairables can be repaired a limited number of times. Limits to repair are a specific number of repairs, or damage limits. Rotables are more complex components with higher list prices, and can have an unlimited number of repairs. These include: avionics; electrical components; hydraulic and pneumatic system components; servos and moving flight control surfaces; and heavy components such as landing gears and thrust reversers.

The fifth category comprises life-limited parts (LLPs), including safety equipment such as oxygen bottles, emergency slides and lifejackets.

The sixth category is structural parts, used exclusively in structural repairs.

The seventh category comprises large parts used in interior furnishings and refurbishment, including: seat frames, covers and cushions; carpet and flooring material; sidewall and ceiling panels; bulkheads; galley and lavatory structures and equipment; cabin lighting; and passenger service units.

Maintenance categories

The cost of owning, repairing and managing all types of materials, consumables, components, structural parts and interior furnishings is not simply applied to airframe checks. The cost of materials has to be sub-divided, and can be allocated to different categories of airframe maintenance.

Airframe maintenance is divided into: line and light maintenance; A checks; out-of-phase (OOP) checks and unscheduled repairs; heavy component and engine changes; and base maintenance, which may be sub-divided into C checks, heavy checks, interior refurbishment, and stripping and repainting, depending on how operators arrange the workscopes of base checks. Base checks will often combine heavy checks with a C check, as well as including interior refurbishment and aircraft painting. Engine and heavy component changes are often scheduled with base checks, as well as A checks.

Base check materials

Consumables are non-aircraft parts, and so are used at all levels of airframe maintenance, and the cost of materials therefore has to be budgeted accordingly.

Expendables are also used at every type of airframe maintenance visit. Their consumption can be predicted relatively accurately for routine tasks, but for non-routine rectifications and repairs, this is less predictable.

Only some repairables are consumed during airframe checks. Airframe repairables, such as panels, skins, flight surfaces and less complex components, such as radomes, should be included in the cost of airframe checks.

Other repairables that are constituent parts of heavy components, such as brake discs and tyres, should be considered as part of rotable or heavy component maintenance costs, and so should not be included in airframe maintenance costs.

Rotable components can be sub-divided into several categories. The first is heavy components, including: landing gears; wheels; brakes; thrust reversers; and the auxiliary power unit (APU). These should be regarded as separate and unrelated to airframe maintenance.

The second is airframe rotable components, and comprises most rotables in the aircraft. These are termed line replaceable units (LRUs), since they can be removed and replaced relatively quickly during line maintenance.

Most airframe rotable LRUs are maintained on an on-condition basis, so they are removed and replaced during line maintenance as they fail or develop problems. The cost of their repair, ownership and management is therefore regarded as separate to all other elements of aircraft maintenance.

The A340-300 entered service with a basic C check interval of 15 months, and a base check cycle of eight checks which had a full interval of 10 years. TAP's fleet has almost completed two full base check cycles.

Aircraft systems are tested during airframe checks. This can reveal faults with rotables, which are then removed, repaired and replaced. The cost of this should nevertheless be regarded as a separate element of aircraft maintenance.

A minority of airframe rotables are LLPs, which have fixed life limits. These are safety items, such as oxygen bottles, emergency equipment, and batteries. The replacement cost can still be regarded as part of total rotable costs, rather than airframe maintenance. Some airlines may still budget for the use of these as an element of airframe maintenance checks.

The third category of rotables is engine accessories and LRUs. These should also be included in the overall cost of rotables, rather than as part of airframe or engine maintenance costs.

Structural parts are changed and installed only during airframe maintenance checks, so their cost should be budgeted for as part of base checks.

Budgeting for interior furnishings is complicated by the fact that small amounts of parts are used in all A and base checks on an ad-hoc basis at every check, while major interior refurbishment takes place at intervals of several years.

The five main categories of materials that should be included in base check costs are: consumables, expendables, some repairables, structural parts, and interior furnishings. Repairables related to heavy components and rotables, and LLPs should not be included in budgets for base checks.

Material utilisation

Each category of materials is used differently in base checks. Base checks can be sub-divided into four main categories of tasks and inspections.

The first is routine inspections that are specified in the maintenance planning document (MPD) and aircraft maintenance manual (AMM). These are mainly servicing, functional, zonal and structural tasks.

Most airlines add to routine inspections with tasks relating to: safety-related maintenance; cabin interiors and testing of in-flight entertainment (IFE) equipment; engine and component changes; stripping and repainting; and interior cleaning and refurbishment.

The number of routine inspections will remain relatively stable during the life of the aircraft. They can increase, however, with aircraft age, as corrosion inspection and control programme (CPCP) inspection tasks come due for the first time and then have to be repeated with increasing frequency. CPCP tasks can be regarded as an ageing aircraft in some types, while they have become an integral part of the MPD in others.

Other ageing programmes may arise unpredictably as a type gets older. These can include the supplemental structural inspection document (SSID), the enhanced zonal analysis procedure (EZAP), the electrical wiring interconnection system (EWIS), repair assessment programme (RAP), and widespread fatigue damage (WFD) programmes that have arisen for the 747-400 *(see Assessing the 747-400's ageing maintenance, Aircraft Commerce, August/September 2012, page 43)*.

These, and other, ageing programmes all involve routine inspections. An aircraft's routine maintenance requirements therefore increase with age as these programmes are issued.

Routine inspections and ageing aircraft programmes will always use consumables and expendables. Routine tasks specified in the AMM have the expendables required list, so it is relatively easy to predict their consumption. Inspections for ageing aircraft programmes and the CPCP mainly use consumables.

The second category of base checks tasks are non-routine defects, repairs and rectifications that arise out of findings made during routine inspections. The type of non-routine maintenance and rectifications will depend on the type of routine inspections being performed.

First, the ratio of MH for non-routine inspections to MH for routine inspections steadily increases with aircraft age. Items such as lightbulbs, brackets, tubes and pipes will all start to deteriorate and need replacement as the aircraft ages. The consumption of materials for non-routine rectifications is higher per MH than for routine inspections. It is also harder to predict the consumption of materials for non-routine rectifications. Different types of inspection will therefore have different rates of consumable and expendable consumption.

Non-routine rectifications also consume some repairables. The ratio of repairs and parts replacement increases with aircraft age. The use of repairables is relatively low when the aircraft is young. The consumption of repairables increases with age, and can exceed that of consumables by the time the aircraft reaches 20 years old. Most repairables tend to be interior and cargo bay items in the earlier part of an aircraft's life. The portion of interior furnishing items increases as the aircraft gets older.

The consumption of structural parts also increases, particularly in the second part of the aircraft's life.

Regular routine zonal inspections of certain parts of the aircraft, such as the landing gear wells, cargo bay and flap screwjacks, can find corrosion damage.

The CPCP inspections will find any corrosion damage to aircraft structures. The non-routine rectifications that arise as a result will use cleaning and treatment fluids, which are consumables. They can also require the replacement of structural parts. The expendables used will be items such as bushings and insulation blankets.

The ratio of materials consumption

For the A340-300, TAP has recorded that the consumption of labour for the full eight checks of the second base check cycle was about 52% higher than the eight checks for the first cycle. The increase in material consumption for non-routine items increased at about twice the rate of non-routine labour.

will be high where corrosion and structural damage are found, but also hard to predict. The rate of consumption is partly driven, however, by aircraft age.

Airworthiness directives (ADs) and service bulletins (SBs) require inspections and modifications to be made. These are not MPD and AMM routine inspections or the non-routine defects and rectifications that arise out of routine inspections, and so should be regarded as a third, separate category of maintenance.

AD and SB inspections can give rise to findings and defects, and therefore rectifications. The MH for these could be regarded as part of ADs and SBs, or as an element of non-routine maintenance.

The routine inspections for ADs will consume small levels of consumables and expendables. ADs have terminating action, which is non-routine maintenance. ADs that involve structural inspections will use a large amount of consumables, such as treatment fluids, and structural parts for terminating actions or non-routine rectifications.

This third category also includes an airline's own modifications and engineering orders (EOs). Many modifications include changes to an aircraft's interior, such as installing new-style seats in premium cabins and later-generation IFE equipment. These improvements should be considered separate to the regular cost of materials used during base maintenance, however.

The fourth main element of base checks is interior refurbishment. Some will be performed on an ad-hoc basis with small repairs during all levels of A and base check. Large interior refurbishments will be performed at heavier base checks.

Interior refurbishment will use mainly consumables, expendables and interior furnishings. Furnishings include seat covers and cushions, panels and flooring material, galley and toilet structures, and even overhead bins. A few repairables and structural parts may be used.

Budgets for materials

Budgeting for materials can be illustrated by what is used in an aircraft's successive base check cycles.

Air Portugal operates four A340-300s, which were introduced in 1994 and 1995, and have been operated on a fairly standard base maintenance programme.

"At service entry the aircraft had a standard C check MPD interval of 15 months. The base check cycle comprises eight checks, so is completed at the C8 check, which then had a maximum interval of 10," explains Caetano Almeida, engineering maintenance programs at TAP Maintenance & Engineering. "In addition to the main groups of C check tasks and C checks, there are also the two main groups of structural inspections. At this stage they had intervals of five and 10 years. The five-year tasks would ideally be combined with the C4 check, because this check had a lot of deep inspections and also had a five-year interval. The C8 check would ideally be combined with the five- and the 10-year inspections, since all three groups involve deep inspections and all come due at the same time. This was possible in the first base check cycle."

The C check intervals were later escalated to 18 months, and the C8 check to 144 months. The five-year and 10-year inspections were increased to six-year and 12-year intervals. This means that the C4 check could still be combined with the six-year tasks, and the C8 check with the six-year and 12-year tasks.

Check interval escalations, however, did not actually occur at the same time, so five/six-year and 10/12-year structural inspections have not always been in phase with C4 and C8 checks. Also, not all five-year and 10-year tasks got escalated to six- and 12-year intervals. The tasks that remained at five- and 10-year intervals have had to be combined with C7 checks in the second base check cycle.

TAP's four A340-300s completed their first base check cycle in January-April 2003. The first base check cycle therefore lasted about eight years.

The first C1 checks were performed in January-March 1996. The four aircraft had the C4 checks, with structural inspections, and a cabin retrofit in the spring of 1999. The four aircraft underwent their C8 checks with 5-year and 10-year tasks in January-April 2003.

The C1 checks of the second base check cycle were performed in early and late 2004. The aircraft have now passed the C7 checks of their second base check cycle, and will complete the second cycle in late 2013 and early 2014. This second cycle will therefore have taken just over 10 years to complete.

Almeida says MH inputs for base checks are sub-divided into three main groups. The first is MH for protocol tasks, which are mainly MPD routine tasks. Besides C check and 5/6-year and 10/12-year tasks, the routine tasks in base checks were added to by A checks.

"The second group is extra-protocol, and usually uses a larger number of MH than the protocol group," explains Almeida. "This group includes ADs, SBs, EOs, and customer-specific items, such as cabin and interior items, and customer modifications. With some aircraft, the MH used for the extra-protocol group were high early in life, and were only reduced later in life."

The third group is the discrepancies or non-routine rectifications arising from protocol and extra-protocol tasks. Almeida says the discrepancies ratio for protocol and extra-protocol varies widely.

The sub-total of these three main categories is almost all the MH used for completing the check. TAP M&E has broken this sub-total by areas that the MH relate to: engines; cabins; flight controls and landing gear; electrical and avionics; structural; cabin structural items

The labour requirements and consumption of materials will be inflated for a base check where a large number of modifications, or an interior refurbishment programme is included.

(including items such as flooring and galleys which are repaired in shops); cabin interiors that are repaired in the hangar; cabin interiors that are repaired in shops; painting; and the mechanical support required to complete the check.

Labour inputs

A large number of the checks carried out on TAP's A340-300 fleet have included substantial inputs for extra-protocol items, and the number of MH used in each category illustrates which part of the aircraft has been affected by the items that are additional to the MPD.

The materials required for the protocol part of the check will be fairly predictable, since they are routine MPD A and base check inspections.

The extra-protocol items in the base checks performed on TAP's A340-300 fleet varied widely, and added substantial MH requirements to the check.

"All C checks included some ad-hoc interior work, a small amount of exterior painting, and some ADs, SBs and modifications," says Almeida.

Some more substantial items are added to most checks in the two base check cycles, which are almost complete.

1st base cycle

The C1 checks had just C check tasks, but some of them still had an extra-protocol content *(see table, page 32)*.

The first check with a noticeable extra-protocol content was the C3 in the first base check cycle. This included the addition of the low rate initial production (LRIP) programme for the earlier built A340-200s/-300s. This involved many modifications, and consumed a large number of MH *(see table, page 32)*. "This programme was also joined by a major AD that required a modification to the sixth wing rib, where the main landing gear is attached," says Almeida. This increased the MH used for the structural element of the check, and mechanical support.

The C4 checks in the first cycle were added to by a large group of modification SBs that required a large increase in MH used for engine-related maintenance, the cabin items, structural tasks, cabin structures, and mechanical support. Total MH for the check averaged 16,100 for the four aircraft *(see table, page 32)*.

C5 checks had a relatively small MH input for extra-protocol, but the C6 checks had a substantial addition *(see table, page 32)*. The fleet standardisation improvement programme (FSIP) was a large packet of modifications, and was incorporated into TAP's fleet in these checks. This led to a relatively large number of MH being used in cabins, and flight controls.

The first C7 and C8 checks also had a relatively high consumption of MH for extra-protocol items *(see table, page 32)*. The C8 check included 5-year and 10-year structural tasks in the protocol items, so 5,500-6,000MH were used for structural items. The MH for the high protocol content increased MH used for cabin refurbishment and aircraft painting, some of which are included in the protocol portion. In most cases, C1 to C7 checks used 100-400MH for a small amount of exterior painting. The C8 checks used 1,200-1,700MH for painting, as the aircraft were repainted during these checks. Total protocol input was 6,700MH, extra-protocol used a similar number of MH, and a 96% non-routine ratio resulted in a labour input of 12,913MH for discrepancies. This took total labour for the check to 26,300MH *(see table, page 32)*.

Total average MH for the eight checks in the cycle were 81,000MH per aircraft *(see table, page 32)*, split between 17,600MH for protocol, 26,200MH for extra-protocol, and 37,200MH for discrepancies. This gives an overall routine to non-routine ratio of 1.0:0.85; with protocol and extra-protocol regarded as routine inputs.

2nd base cycle

The second base check cycle has seen a virtual doubling of MH for the first seven checks in the cycle compared to the first seven checks of the first cycle.

The second C7 check workscope was increased in size because some of the five-year and 10-year tasks were included in the check. "The five- and -10-year major structural tasks had their intervals escalated to six and 12 years. Some tasks in these two groups had to remain at five and 10 years, however, if certain large structural modifications had not been performed," explains Almeida. "The items that stayed at five and 10 years are the parts of the aircraft that are affected by humidity, whose inspections require the removal of galleys and lavatories. So unless the modifications were made, it made sense to keep the six-year tasks at a five-year interval, and the 12-year tasks at a 10-year interval.

"These major modifications are addressed in three service information letters (SILs) issued by Airbus in 2002 and 2003," continues Almeida. The SIL numbers are 053-085, 053-091 and 025-116, and relate to the cabin floor, and preventing seat track and cabin corrosion. These tasks are voluntary and also expensive, so we did not make the modifications, and the tasks stayed at five- and 10-year intervals and had to be included in the C7 check. The tasks escalated to six- and 12-year intervals will be grouped into the second C8 check."

The first C8 checks were performed in early 2003, and the second C7 checks came due in mid and late 2012; about nine and half years later. Almeida says

LABOUR & MATERIAL INPUTS FOR A340-300 BASE MAINTENANCE

Base check	Protocol MH	Extra-protocol MH	Discrepancy MH	TOTAL MH	Protocol materials-$	Extra-protocol materials-$	Discrepancy materials-$	TOTAL materials-$
1st base check cycle								
C1	290	1,072	888	2,250	9,414	1,238	18,995	29,650
C2	678	970	1,252	2,900	8,093	2,223	30,144	40,459
C3	701	4,328	2,420	7,449	5,670	79,757	62,883	148,309
C4	4,114	4,488	7,496	16,097	25,271	44,628	215,407	285,306
C5	1,111	1,977	3,209	6,297	11,721	70,371	89,499	171,591
C6	1,827	3,053	4,426	9,306	24,994	77,489	124,109	226,593
C7	2,174	3,569	4,538	10,280	66,099	120,094	240,221	426,414
C8	6,676	6,713	12,913	26,302	107,500	371,600	382,600	873,600
Total 8 checks	**17,600**	**26,200**	**37,100**	**80,900**	**258,800**	**767,400**	**1,163,900**	**2,201,900**
2nd base check cycle								
C1	1,530	4,211	3,474	9,214	46,800	167,600	196,800	418,000
C2	1,553	2,666	4,700	8,918	36,750	107,300	199,100	343,100
C3	2,887	5,462	7,063	15,411	35,000	144,000	314,400	494,100
C4	3,898	2,324	8,354	14,600	35,800	104,300	387,100	527,200
C5	1,777	2,704	5,118	9,599	32,000	90,500	189,800	312,300
C6	2,354	3,058	7,718	13,130	16,900	96,600	573,100	686,600
C7	4,040	8,400	10,900	23,325	28,900	267,600	349,600	646,300
C8 - estimated	7,350	7,350	14,200	28,900	118,000	410,000	421,000	950,000
Total 8 checks	**25,387**	**36,158**	**61,528**	**123,100**	**350,200**	**1,387,900**	**2,630,900**	**4,376,600**

TAP M&E's planning department estimates the second C8 checks will consume plus or minus 10% of the MH and materials used in the first C8 checks.

Two aircraft included a business-class seat retrofit in their second C1 checks, so MH for the cabin portion of the check were higher. Also, A check tasks and landing gear changes that were added overall made the MH input into these checks about four times higher than they were in the first base check cycle *(see table, this page)*.

C2 checks were also about three times larger than they were in the first base check cycle *(see table, this page)*. The MH used for cabins and structural tasks were higher. The non-routine ratio was also higher, at 111% compared to 76%.

C3 checks included: an aircraft repaint, which used 3,200MH; and a large cabin refurbishment, which used 6,700MH. These two elements account for 65% of the total input for the check. The inputs for the protocol element were four times higher than the C3 checks in the first cycle *(see table, this page)*, and the non-routine ratio was almost twice the rate at 85%.

The C4 checks were similar in total MH to the same checks in the first cycle. These checks included the 5/6-year tasks. The absence of a cabin refurbishment in the second C4 check, however, reduced MH for extra-protocol, but a high non-routine ratio of 135% resulted in similar total MH to the first C4 check. The second C4 check would have been larger if the cabin had been refurbished in this check, rather than in the C3 check.

Despite being similar in workscope to the C5 check in the first cycle, the C5 check in the second cycle used 600MH more for protocol tasks, 700MH for extra-protocol tasks, and 1,800MH more for discrepancies, taking the total to 3,300MH higher than in the first cycle. A large number of MH were used for cabin work in the second C5 check.

The second C6 check only had A check tasks in addition, unlike the FSIP that was included in the first C6 check. This reduction in protocol and extra-protocol tasks was offset by a higher non-routine ratio of 143%. Total labour input was therefore 3,800MH higher *(see table, this page)*.

The C7 check included 5-year tasks and 10-year tasks. Two aircraft also had a new set of IFE equipment installed, so labour for the protocol portion was 1,900MH higher, and the extra-protocol was almost 5,000MH higher than the previous C7 check *(see table, this page)*. A high non-routine ratio of 88% generated a non-routine labour requirement of 10,900M, taking the total check to 23,300MH. This is 3,000MH less than the C8 check in the first cycle.

It is estimated that the second C8 check, which will include the six- and 12-year tasks, could use up to 10% more MH and materials than the first C8 check. The check is likely to include a repaint of the exterior. Total labour could therefore reach about 29,000MH.

If this amount of MH is actually used as forecast, then labour consumption for the whole base check cycle of eight checks will be about 30% higher than the first base cycle. The overall routine to non-routine ratio wil be 1.0:1.0.

Material cost analysis

The materials used by TAP M&E for these two C check cycles for its A340-300 fleet reveal interesting trends. These costs include all categories of materials except for rotable components. The costs include consumables, expendables, repairables, structural parts, and interior furnishings.

1st base cycle

Material costs have been recorded for protocol, extra-protocol and discrepancies. All material costs were low in terms of cost per MH for the first two checks, which is expected. Materials for protocol inputs were $9,400, which was high. However, inputs for extra-protocol and discrepancies were low, compared to later checks. They were almost non-existent for extra-protocol, and equalled $15 per MH for discrepancies.

"It is relatively easy to predict the material consumption for protocol inputs," says Almeida. These were $6-16 per MH for most checks in the first cycle. Actual cost was $5,700-107,000, depending on the size of the MH input and check *(see table, this page)*. The C7 check, which had a higher input, was the exception.

"Materials for the extra-protocol vary highly in relation to MH, depending on which ADs, SBs and EOs are included in the check, and on the mechanic skills used," says Almeida. "There is generally

Over the course of two base check cycles, the overall cost of materials per MH consumed for A340-300 base maintenance remained within a relatively constant range. The $ cost of materials used for non-routine portions of a check could reach high rates per MH consumed, depending on workscope content.

no linear relationship between the MH used and the cost of materials. It is harder to predict what materials and parts will be used when structural items are included in the check, because it is hard to predict how much corrosion and fatigue will be found. Corrosion and fatigue consume a lot of materials, such as treatment fluids and structural parts."

Material expenditure for extra-protocol inputs was proportionately higher, not only because a higher quantity of MH were consumed, but because these tasks consume a higher rate of materials per MH. Consumption was low, and almost zero for the first two C checks. This is perhaps unsurprising, given that the aircraft were still young at this stage. Only small SBs would be applied.

The rate at which materials were required for later checks climbed from the C3 check. The rate per MH was highly variable, at $10-34 per MH. Costs per check were far more variable than MH. The C3 had a high rate of materials and parts, due to the LRIP programme.

The C6 check similarly had a high rate of materials for extra-protocol items, partly because the LRIP programme was included. Unsurprisingly, material costs were highest for the C8 check, which was $372,000.

The overall rate of material costs for extra-protocol was $29 per MH, twice the rate for protocol inputs.

As with extra-protocol, the rate of material consumption for discrepancies is high compared to protocol. There was a degree of variation over the eight checks at a rate of $15-44 per MH. The highest rate was the C7 check, which did not have the highest non-routine ratio. Checks with large modifications such as the LRIP and FSIP did not have noticeably higher material costs. The C8 check, as expected, had one of the highest rates of material costs at $30 per MH, and an actual cost of $382,000 *(see table, page 32)*. This is unsurprising, given that the aircraft had a large amount of overall inputs for interior refurbishment.

Total cost of materials for the eight checks was $2.2 million, equal to an overall rate of $27 per MH: $259,000 for protocol inputs, $767,000 for extra-protocol, and $1.164 million for discrepancies.

2nd base cycle

Material costs were noticeably higher for the second base check cycle. While more MH were used for the protocol, extra-protocol and discrepancies labour inputs, material consumption rates for protocol inputs were about the same in the second base check cycle as they were in the first cycle. That is, a rate of $13 per MH over the complete cycle.

The rate of material consumption for the second cycle was $34 per MH, $5 per MH higher than in the second cycle. A small increase is perhaps not surprising, but the tasks are still routine.

The biggest rise comes from materials and parts for the discrepancies portion of the checks. The rate of material consumption was $47 per MH, 50% higher than the first base check cycle. The overall non-routine ratio for labour in the first base check cycle was 85%, climbing to 101% in the seven checks of the second cycle.

Like the first base check cycle, the rate of material consumption per MH for the discrepancies varied highly at $33-72 per MH. Perhaps surprising is that the C7 check, with the five- and 10-year tasks had the lowest rate, while the C1 and C6 checks had the highest. Two aircraft had new seats fitted during C1 checks, which raised a lot of material requirements. The C6 check had the highest non-routine ratio for labour of all base checks carried out on the aircraft: an average of 143%. This will have generated a high material requirement.

Total cost of materials for the seven checks of the second base check cycle was $3.4 million, $1.2 million more than the eight checks of the first cycle. The cost of materials for protocol inputs was $232,000, $106,000 higher than for the first seven checks of the first cycle. The rate per MH was similar in the second cycle, however, at $13 per MH.

Material costs for extra-protocol inputs was $978,000, $660,000 more than in the first cycle. The rate per MH was about 60% higher than in the first cycle, perhaps explained by a higher incidence of ADs, SBs and modifications.

Materials for discrepancies was $2.2 million for all seven checks. This includes the five- and 10-year tasks that were part of the C7 check, and which normally would be carried out in the C8 check. The total material cost for the C7 check was $646,000, a surprising $230,000 less than in the C8 check in the first cycle.

The overall rate of material cost per MH in the second base cycle was $36, 33% higher than the first base check cycle. The rate of material consumption for discrepancies has therefore risen about twice the rate of the MH for non-routine labour.

Summary

Despite there being no apparent correlation between MH and materials, the consumption of material per MH in the two base check cycles has remained relatively constant. Total expenditure on materials has increased in proportion with labour.

While it may be hard to predict cost of materials for individual tasks and checks, the overall pattern over the long term is relatively predictable. Checks with a high material consumption per MH will be high in interior refurbishment, major modifications, or large ADs and SBs. AC