"Backfit" RCM Road Map

AGE DEGRADATION (First Filter) Does Failure Mode Occur?

Step 1: Identify Functional Failure and Failure Mode

Step 2: Does the Failure Mode actually occur in Service Life?

- **No** → No Degradation or Acceptably Slow Rate of Degradation → No Task
- **Yes** → Step 3:

Step 3: Determine/Classify Type Task

Name	CONDITION DIRECTED (CD)	TIME DIRECTED (TD)	FAILURE FINDING (FF)	SERVICING (S)	LUBRICATION (L)
Action	"Renew Life" (restore/replace) Based on measured condition compared to a standard	"Renew Life" (restore/replace) regardless of condition	Determine whether a functional failure has already occurred	Add/replenish consumable (e.g. windshield washer fluid)	Oil, grease, or otherwise Lubricate
Circumstance	Equipment characteristic corresponding to potential failure	Imminent wearout	Failure of off-line or "hidden" function (e.g. safety/ protective devices)	Reduced level of operating consumable	Accelerated wear

APPLICABILITY (Second Filter) Task Restores or Maintains Original Reliability?

Step 4: Is the Existing Maintenance Task *Applicable*?

Apply Rules for Applicability
ALL rules must be satisfied for each task type

CD: Health Monitoring
- Can equipment characteristic corresponding to the specific failure mode be identified?
- Can that characteristic be measured *accurately* and *consistently*?
- Is there enough time between potential and actual failure to take action?

TD: Life Renewal (Replace/Restore)
- Does the probability of failure increase significantly at a specific age? (evidence of WEAROUT)
- Does a large portion of the population survive to that age?
- A potential failure point does not exist or cannot be measured?

FF: Hidden Failure (Find/Repair)
- Is the functional failure hidden to operating crew in normal operations?
- An applicable CD or TD task does not exist?

S/L: Servicing and Lubrication
- Applicable by default

- **No** → Review Improvement Options → **Yes** → Can Task Be Modified To Form an *Applicable* Task? → **No** → **Step 4a:** No Task
- **Yes** → Task Does Satisfy Applicability Rules → **Step 5:** Identify Functional Failure Consequences

Safety or the Environment
- Personnel safety (life or limb) or Law

Operational performance
- Ability to perform ship's mission

All other failures
- Not impacting safety, law, or mission

EFFECTIVENESS (Third Filter) Is Task Worth Doing?

Step 6: Is the Maintenance Task *Effective*?

Apply Rule for Effectiveness

Safety or the Environment (Law)
- Reduces probability of failure to an acceptable level

Operational performance (Mission)
- Reduces risk of failure to an acceptable level

All other failures
- Cost of PM is less than cost of repair plus cost of lost capability

- **No** → Review Improvement Options → **Step 6a:** Can Task Be Improved To Form an *Effective* Task?
  - **Yes** → Step 4
  - **No** → No Task
- **Yes** → Task Does Satisfy Effectiveness Rule → **Step 7:** Can Task Be Improved?
  - Document Changes → Schedule Task

"Backfit" RCM Analysis Process Steps

1. ***Identify the functional failure and failure mode each task is intended to prevent***
   - Functional failure = unsatisfactory condition
   - Failure mode = material condition after failure
2. ***Evaluate age-reliability relationship of equipment***
   - Based on operational experience, does this failure mode actually occur?
   - Info sources/data are best, valid practical experience is OK.
   - Folklore and mythology are out.
3. ***Classify the task***
   - Time-Directed (TD), Condition-Directed (CD), Failure-Finding (FF), Servicing (S), or Lubrication (L)
   - This forms the basis for applying the Applicability rules
4. ***Apply rules for Applicability***
   - Failure to meet *any* rule requires change
5. ***Identify Failure Consequences***
   - Consequences are: Safety/Law, or Mission, or All Others
   - This forms the basis for applying the Effectiveness Rule
6. ***Apply rule for Effectiveness***
   - Failure to satisfy appropriate rule requires change
7. ***Develop recommendations for change***
   - Applicable and Effective tasks CAN still be improved, see following recommendations.

"Backfit" RCM Task Improvement Options

◆ **Applicability**
- Change task type (e.g. TD to CD)
- Change scope/requirements (standards/procedure)
- Change measure of age (operating hours, start/stop)
- Fix when failed (non mission critical)
- Delete maintenance administrative procedures from PMS or CMP.

◆ **Effectiveness**
- Extend periodicity
- Change scope/requirements (standards/procedure)
- Change measure of age (operating hours, start/stop)
- Combine with related tasks
- Fix when failed (non mission critical)
- Perform as operational tasks outside of PMS
- Use sampling vice 100% inspection of population

RCM Task Validation Terms

Age Degradation – Evidence of decreased resistance to failure with increased age.
Applicable Task – A task or group of tasks is applicable, if and only if, it really does prevent, discover or reduce the impact of the failure mode in question.
Effective Task – A task that "pays for itself" by meeting the rule related to its failure consequence.
Failure Mode – Material condition of an item after failure (i.e., seized bearing)
Functional Failure – Any unsatisfactory condition, from inability to meet required performance standard to complete loss of function

Other RCM Terms

Age: The most appropriate measure of wear on equipment; may be measured by calendar time, duty cycles, operating hours, etc.
Age-Exploration: The process of systematically extending and evaluating task intervals to determine the optimum periodicity.
Dominant Failure modes: The failure modes which account for a significant portion of the failures of an equipment in service. For example: Worn mechanical seal in pump.
Hidden Failure: Functional failures whose effects will not be evident to the Operator/Maintainer during normal operation.
Maintenance: Actions taken to ensure that components, equipment and systems provide their intended functions when required.

NOTE: Maintenance is designed to preserve function, not eliminate the risk of failure. You can minimize risk but you *cannot* eliminate *all* failures.

Potential Failure: An identifiable physical condition which indicates that a functional failure is imminent.
Reliability-Centered Maintenance (RCM): A method for determining preventive maintenance requirements based on the analysis of the likely functional failures of hardware having a significant impact on safety, operations and support functions. RCM provides the rules of evidence of Condition Based Maintenance (CBM)
Risk: Probability of failure times Severity of failure (P_f x S_f). Both Severity and probability of failure must be evaluated objectively for best long term results.
Wearout: The point at which an item has no service life remaining and it must be restored or replace.

For more information contact the
MSC Maintenance Management Systems Branch Head

Version 1/10

Reliability-Centered Maintenance

"Backfit" RCM Analysis Process

Maintenance Effectiveness Review

"Continuously Improving Your Preventive Maintenance Program"

Figure 2