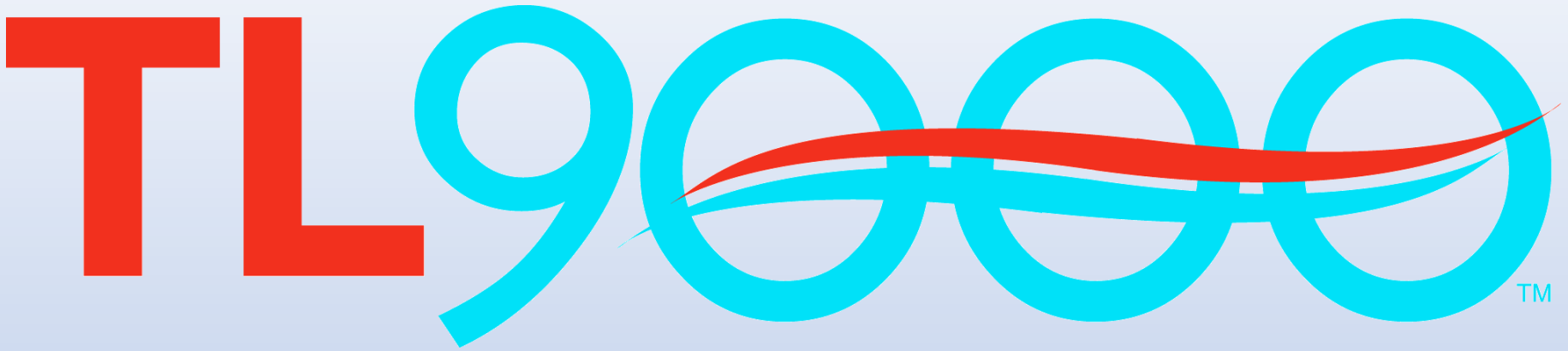



# TL 9000 Return Rate Measures

Tom Yohe

# Topics

## Background

## FR

- Why three return rates
- Rules
- Tips

## BR

- Why not just use FR or ERI
- Rules
- Tips

## Setting goals

# Classical Maintenance Reliability Terminology

- Mean Time Between Failure (MTBF) - excludes NTF returns
- Mean Time Between Removal (MTBR) - includes NTF returns

$$\frac{\text{Operating Time (in hours)}}{\text{Returns}+1}$$

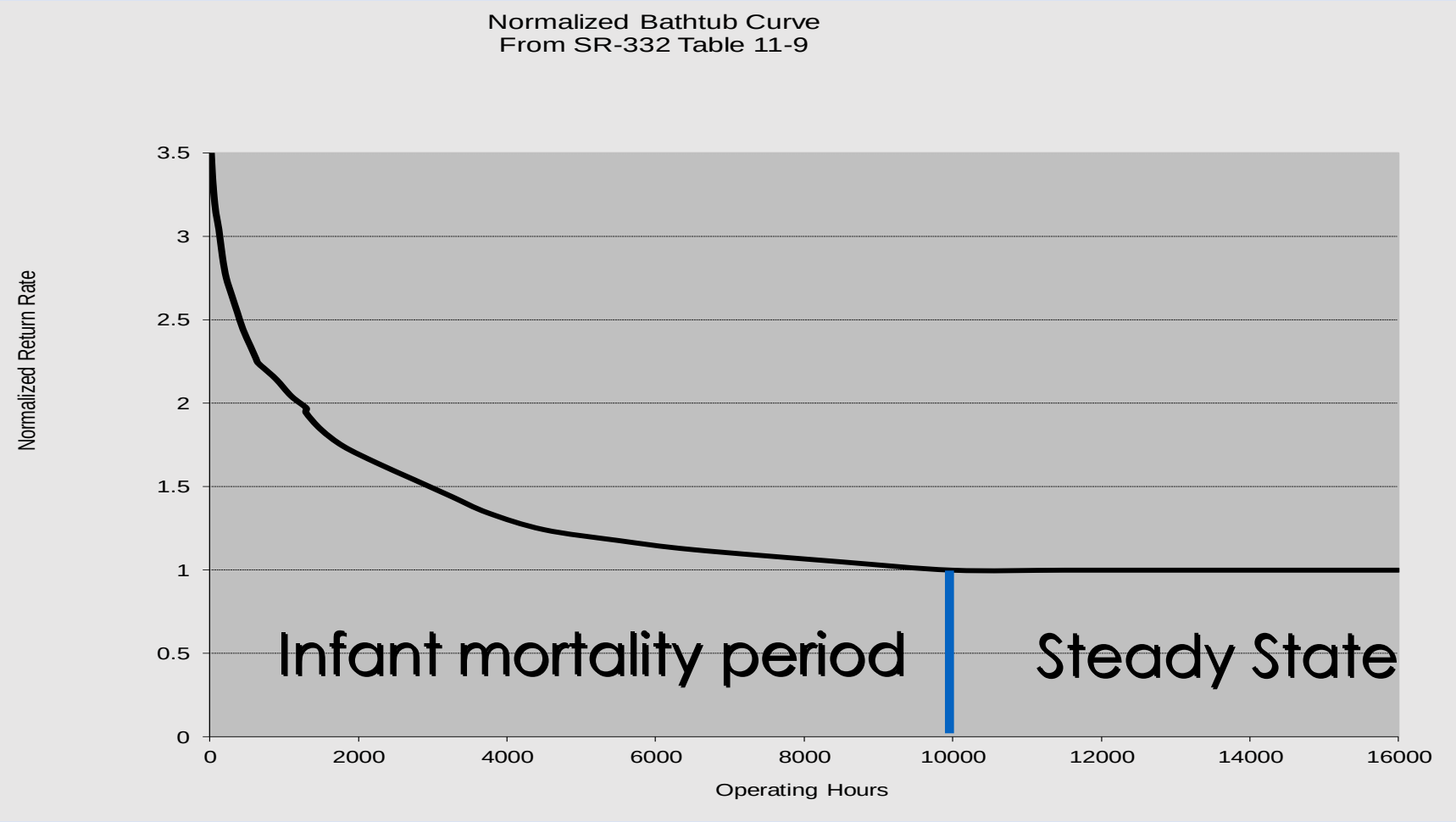
- Return Rate

$$\frac{\text{Returns}}{\text{Operating Time}}$$

- Expressed in terms of returns (or failures) per billion hours
- RITS (Returns in Time) or FITS (Failures in Time)
- Alternatively expressed as

$$\%/\text{year} = 100*\text{FITS}*8766 \text{ hours/year}$$

# Reliability Growth



# Why Measure Return Rates?

## Cost

- Warranty repairs to supplier
- Maintenance to customer
- Spares for both supplier and customer

## Impact on network availability

Note: Return rate rather than failure rate because cost/impact the same to customer and nearly the same to supplier

# Field Replaceable Unit Returns (FR) Calculation

Key Concepts

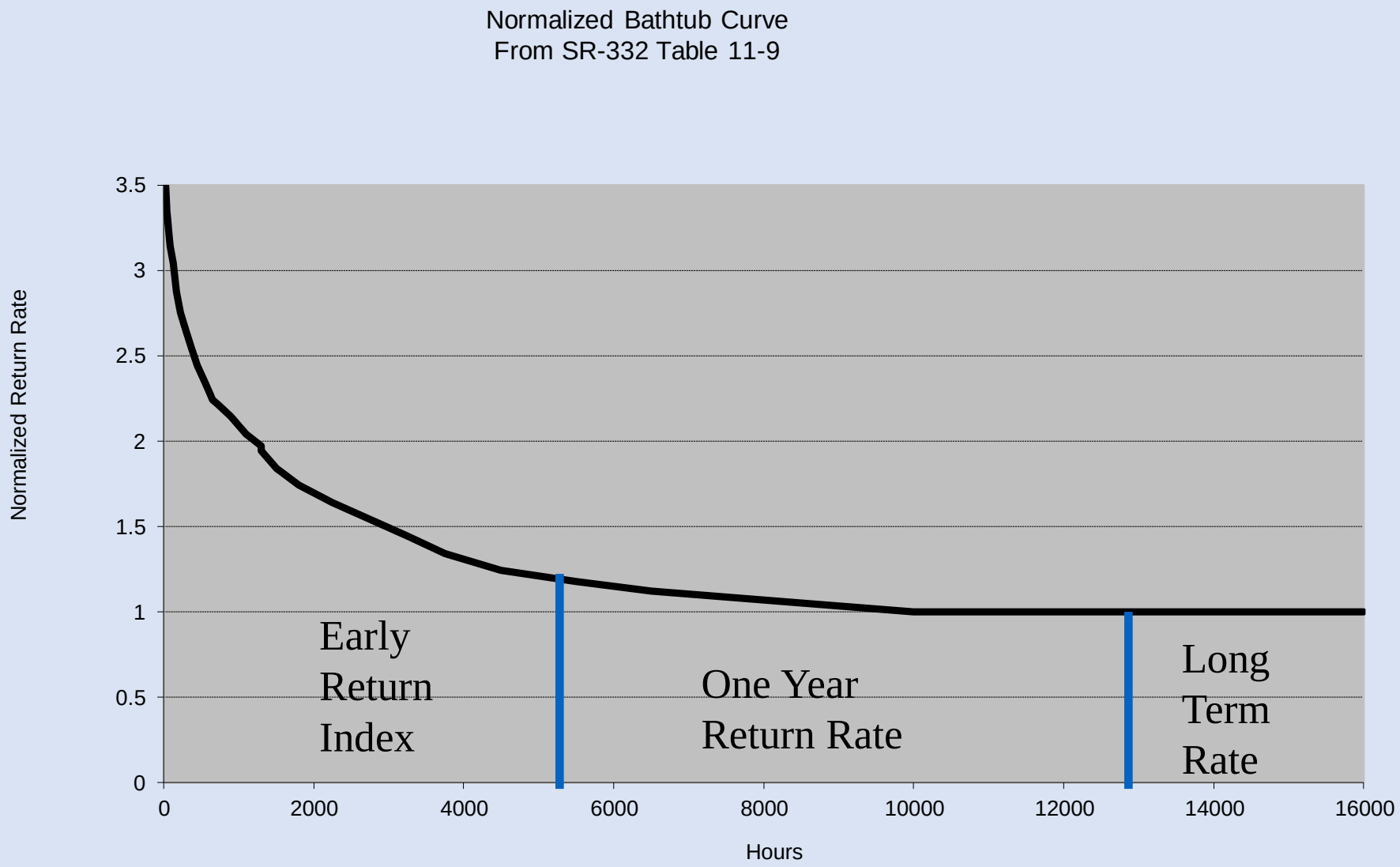
Used to track product returns throughout the product lifecycle

Comprised of 3 return measurements that cover the entire lifecycle

Quantifies the quality of the product as initially received and during subsequent years of operation

Helps to calculate equipment life cycle costs

# TL Return Rates vs. Bathtub Curve



# TL 9000 Return Rates - FR

## Field Replaceable Unit Returns (FR)

- Early Return Index - 0 to 6 months
- One Year Return Rate - 7 to 18 mo.
- Long Term Return Rate - over 18 mo.

All are expressed as per cent per year

# Life Cycle Cost Analysis

- Early Return Index
- One Year Return Rate
- Long Term (Steady State) Return Rate

- Per cent returned makes math easier

For each group of ages sum of

# units * %/Yr. * return cost……

# Calculations

- Each return received in the month counted in one of the three buckets based on when it was originally shipped
- Field population broken into the three groups based on the same shipment time periods

$$\frac{100 * \text{Returns} * \text{Annualization factor}}{\text{Number of Units}}$$

- % returned per year

# Rules

- Apply to Field Replaceable Units (FRU's)
- Return = Any unit returned for repair or replacement due to any suspected mechanical, electrical or visual defects occurring during normal installation, testing, or in-service operation of the equipment.
- Units that fail due to a problem corrected by a recall before they can be rotated are counted as returns.
- Units damaged during normal shipping or handling where the container is not damaged due to abnormal shipping conditions are counted as returns.
- No trouble found units, that is, returned units determined by the organization to meet its specifications, are counted as returns.
- If a returned product contains multiple FRUs, each individual FRU shall be counted separately.

# Rules

- The organization shall document the method of determining which of the returns are from which of the corresponding original basis shipping period. This determination shall be based on the initial shipment to the field of the individual returned unit. This may be determined by
  - serialized shipment records of the returned unit,
  - shipment or warranty start date code marked on the unit,
  - shipment date associated with a customer order, or
  - manufactured date associated with a lot number.
- NOTE: The last method requires the determination of an accounting for a standard time delay between the date of manufacture and shipment.

# Rules

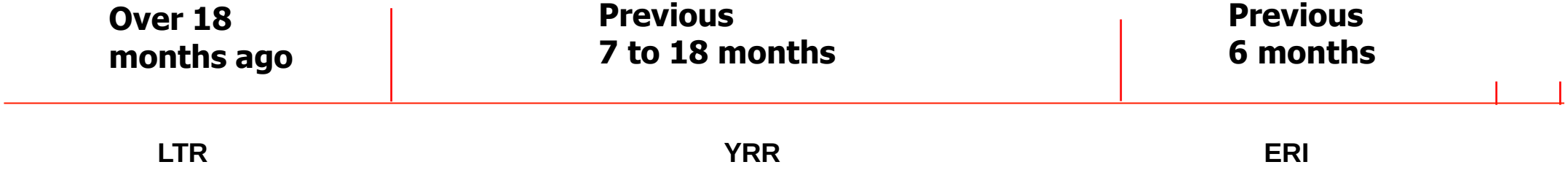
- The date of original shipment to the end customer shall be used for determining the basis shipping period.
- Returns are counted when received by the selling organization or third-party repair/logistics agency.
- Returns and shipments should only be reported once when submitting data to the TL 9000 Administrator. When a unit is used in more than one product and those products span multiple categories, it may not be practical or possible to identify with which product, and therefore which category, a return or shipment is associated. In such cases, the organization should, if possible, apportion the returns and shipments appropriately among all categories in which the unit is used. If accurate apportioning is not possible, the organization may apply all the data for that unit to the most appropriate category.

# Rules – Exclusions from returns and shipments

- working or untested units returned as part of a formal rotation or recall program,
- units damaged during shipping or while in service due to vehicular accidents, water leakage, electrical spikes outside of specified limits, misuse by the end user, or other environmental factors outside those conditions for which the equipment was designed,
- items that were ordered in error, ordered in excess, consignment items, or canceled orders,
- returns from laboratory systems or First Office Application (FOA) systems,
- units returned voluntarily by the customer to install modifications to obtain optional features or functionality or to reconfigure the unit for another use, such as a change in operating frequency,
- units that have been permanently removed from service by the customer, and
- shipments to customers for products where:
  - — defective units are not returned for repair by the customer or
  - — units are repaired by a third-party or the customer and the return data is not made available after solicitation by the organization.

# FR Measurements Basis Periods

| 2020 | | | | | | | | | | | | 2021 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan |
| 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Long-Term Return Rate | | | | | | One-Year Return Rate | | | | | | | | | | | | ERI | | | | | | |



# Equations

**Table 7.1-1 FR Notation**

| Identifier | Definition |
|---|---|
| NU | Normalization Unit (NU) from the Measurement Applicability Table (Normalization Units), Appendix A, Table A-2 |
| Afactor | Number of calculation periods in a year |
| FRri | Number of returns from the ERI basis shipping period |
| FRry | Number of returns from the YRR basis shipping period |
| FRrt | Number of returns from the LTR basis shipping period |
| FRsi | Number of FRUs shipped during the ERI basis shipping period |
| FRsy | Number of FRUs shipped during the YRR basis shipping period |
| FRst | Number of FRUs shipped during the LTR basis shipping period |

**Table 7.1-2 FR Measurement Identifiers and Formulas**

| Identifier | Title | Formula | Note |
|---|---|---|---|
| ERI | Early return index | 100 x Afactor x (FRri / FRsi) | % per year |
| YRR | One-year return rate | 100 x Afactor x (FRry / FRsy) | % per year |
| LTR | Long-term return rate | 100 x Afactor x (FRrt / FRst) | % per year |

# Early Return Index

Surrogate for the installation reject rate

- Number of units shipped readily available
- Number of units actually installed is not available

Very important for identifying new issues

# Early Return Index

Why include returns in report month but not shipments?

Most of the units shipped in the month will not have been installed yet, so not counted in population.

The returns are counted to increase the sensitivity of the measure to new issues

# One Year Return Rate

- “Cleanest” of the three FR measures
  - ERI – varying lengths of time from shipment to actual use (although generally similar for a given category)
  - LTR – difficult to track how many units are still in service or being returned for repair
  - YRR – likely to be in service 6 months after shipment and still in service 18 months after shipment.  Also, likely to be returned to the supplier or cooperative repair supplier
- Best measure to gauge the accuracy of your predictions

# Long Term Return Rate

Needed for

- Overall operating cost calculations
- Maintenance planning
- Identify wear out
  - Electrolytic capacitors
  - Any type of memory device – magnetic or semiconductor
  - Mechanical components
  - High power, high frequency semiconductors

# Data requirements

As a part of its data systems, the organization should have available the information listed above needed to calculate these measurements. This includes:

a) FRU shipping records – These are required to determine which units received for repair are early returns, one-year returns, or long-term returns and to determine the respective populations.

b) FRU return records – The organization's return records shall include the identifiers necessary to match returns with shipment records.

c) Third-party return records – Units returned to a third-party repair agency by the customer or repaired by the customer itself shall be included in the return counts when available. To have accurate measurements, it is necessary for the customer to include a contractual requirement of their third-party repair agencies to supply this data to the original equipment manufacturers.

# TIPS

Build and maintain database with

- Serial numbers or date codes
- Original shipment, return, reshipment, removal from service or no longer trackable dates
- Customer(s)

Don’t update the database until unit received (S/N or PN may differ from RMA)

Continually communicate with customers about third party logistics and repair organizations they use

Continually update return rate predictions and goals based on actual data

# Why BRR

FR does not work for products where their returns/replacements are only traceable during initial usage and not throughout their life.

- Transmission sub-systems
- Antenna systems
- Enclosures/conduits
- Customer Premise Equipment such as phones or modems
- Product of contract manufacturers
- Optical subassemblies

# Basic Return Rate (BRR)

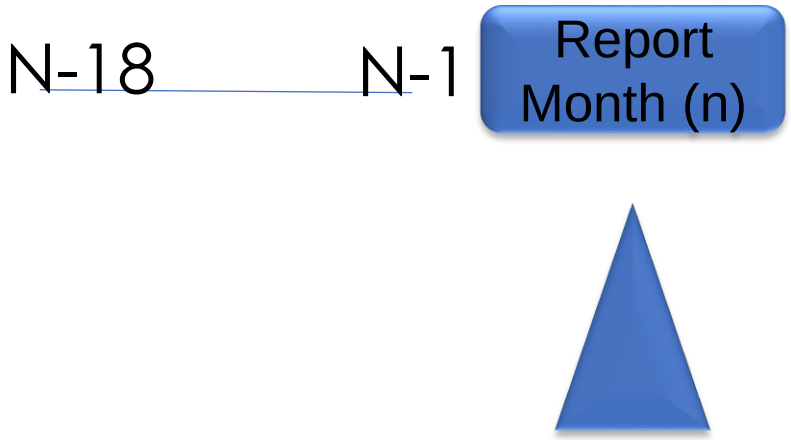
Key Concepts

Insight into the quality/reliability of equipment and services where long term tracking is not practical or expected

Measurement applies to product categories listed in Category Table A-2

BRR includes returns months n-18 through n-1, plus the reporting month (month n)

BRR includes shipments from months n-18 through n-1



# Rules

- Counting rules 1, 2, 3, 5, 6, 7, 9, and 10 in Section 7.1.4 b) shall be applied.
- The organization shall document the method of determining which of the returns are within the eighteen-month basis shipping period. This determination shall be based on shipment of the FRU to the customer. This may be determined by
  - serialized shipment records of the returned unit,
  - shipment or warranty start date code marked on the unit,
  - shipment date associated with a customer order, or
  - manufactured date associated with a lot number.

NOTE: The last method requires the determination of an accounting for a standard time delay between the date of manufacture and shipment.

- The date of shipment to the customer shall be used for determining the basis-shipping period.
- Units which are replaced in the field rather than returned shall be counted in the month the replacement request is received.
- Same exclusions as FR

# Calculation

**Table 7.2-1 BRR Notation**

| Identifier | Definition |
|---|---|
| Afactor | Number of calculation periods in a year |
| FRrb | Number of unit returns from the BRR basis shipping period |
| FRsb | Number of units shipped during BRR basis shipping period |

**Table 7.2-2 BRR Measurement Identifiers and Formulas**

| Identifier | Title | Formula | Note |
|---|---|---|---|
| BRR | Basic return rate | 100 x Afactor x (FRrb / FRsb) | % per year |

# TIPS

Build and maintain database with

- Serial numbers or date codes
- Original shipment, return, reshipment, removal from service or no longer trackable dates
- Customer(s)
- Remove or exclude items 18 months after original shipment

Continually communicate with customers about third party logistics and repair organizations they use

Continually update return rate predictions and goals based on actual data

# Goal Setting

Need to use a standard prediction technique

**Best** – Component failure rates based on your own products' history

**Next best** – Apply a factor based on your products' history to standard rates

**Not very accurate** – prediction based solely on standard rates

# Reliability Predictions

- ANSI/VITA 51.0 (US Military and others)
- MIL-HDBK-217B (US Military)
- 217 Plus (US Military and others)
- PRISM (Reliability Analysis Center)
- CNET 93 / RDF 2000/ HRD5 (European)
- GJB/z 299C (Chinese)
- Telcordia SR-332

All basically same method - each component has a base failure rate, which can be modified by applied electrical, thermal and/or environmental stress

Problems with all component failure rate sources - based on historical field or lab data – field data includes secondary failures, lab data under highly accelerated conditions - all very conservative

Actual mature values should always be better than prediction

# Summary

Tracking and improving your return rates causes

- Decreased costs for you
- Decreased costs for your customer
- Improves customer satisfaction

Elements to set up

- Serial number or date code database
- Adjustment factors for setting goals when using standard failure rate prediction methods