

ANNEX A – ROTATING EQUIPMENT RELIABILITY TEST (TURBOMACHINERY UNITS) (Rev. 0)

The reliability test is intended to demonstrate that turbomachinery unit overcomes the premature failures (“burn in phase”) and provide a reliable operation condition within useful life.

For such evaluation, the reliability test shall be performed for each turbomachinery unit under specific condition (test) and acceptance criteria hereafter described.

1. The test is considered concluded and accepted if the number of countable failures is zero and the accumulated (aggregated) time in service is higher than 240h;
2. If in the meantime any number of countable failures occurs, the procedure below shall be followed as mandatory (see FIGURE 1):
 - a) The turbomachinery unit is considered accepted if it reaches the accumulated time in service indicated in the “Acceptance Zone”;
 - b) If any number of countable failures during the test achieves to the “Rejection Zone”, the turbomachinery test is rejected and a root cause analysis shall be performed to identify failure mechanism and solution be implemented, turbomachinery unit repaired and the test restarted from the beginning. Both, the unit elapsed running time and number of failures shall be disregarded and a new reliability test be carried out;
 - c) Nevertheless, if accumulated time in service and number of failure is within between rejection and acceptance lines the test must go on up to reach the “Acceptance Zone”;
 - d) The test is considered concluded as soon as it reaches the “Acceptance zone” or when it reaches 720h of accumulated (aggregated) time at most with no more than 7 countable failures.

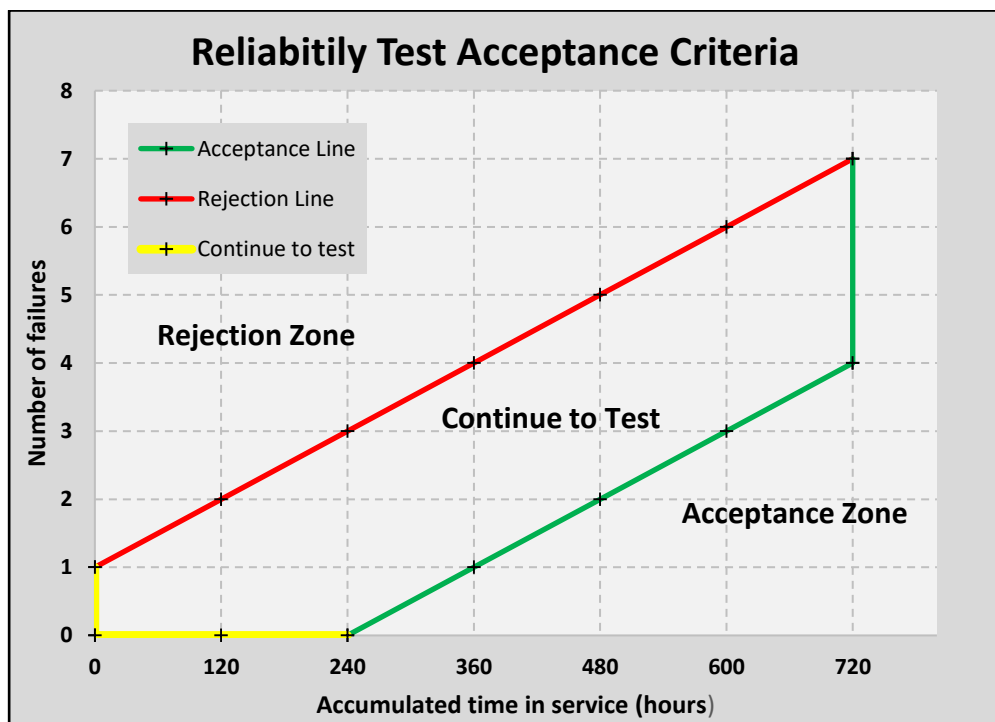


FIGURE 1: ACCUMULATED TIME VERSUS NUMBER OF FAILURES

1. Only failures occurring within the turbomachinery boundaries limits shall be considered (see FIGURES 2A, 2B, 2C, 2D and 2E). Countable failure is any event that causes complete or partial loss of system’s capability of providing its expected output (see APPENDIX 1).

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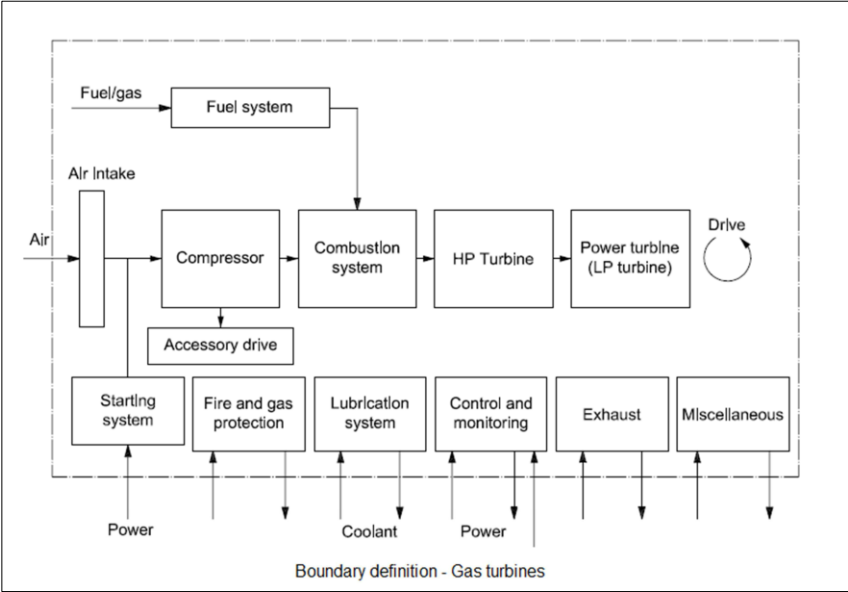


FIGURE 2A

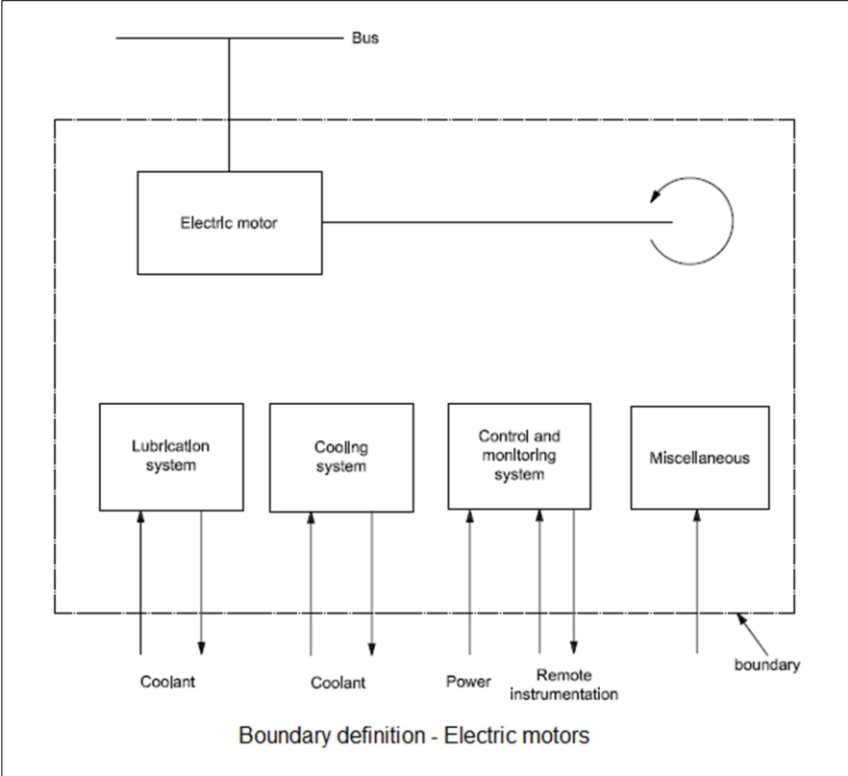


FIGURE 2B

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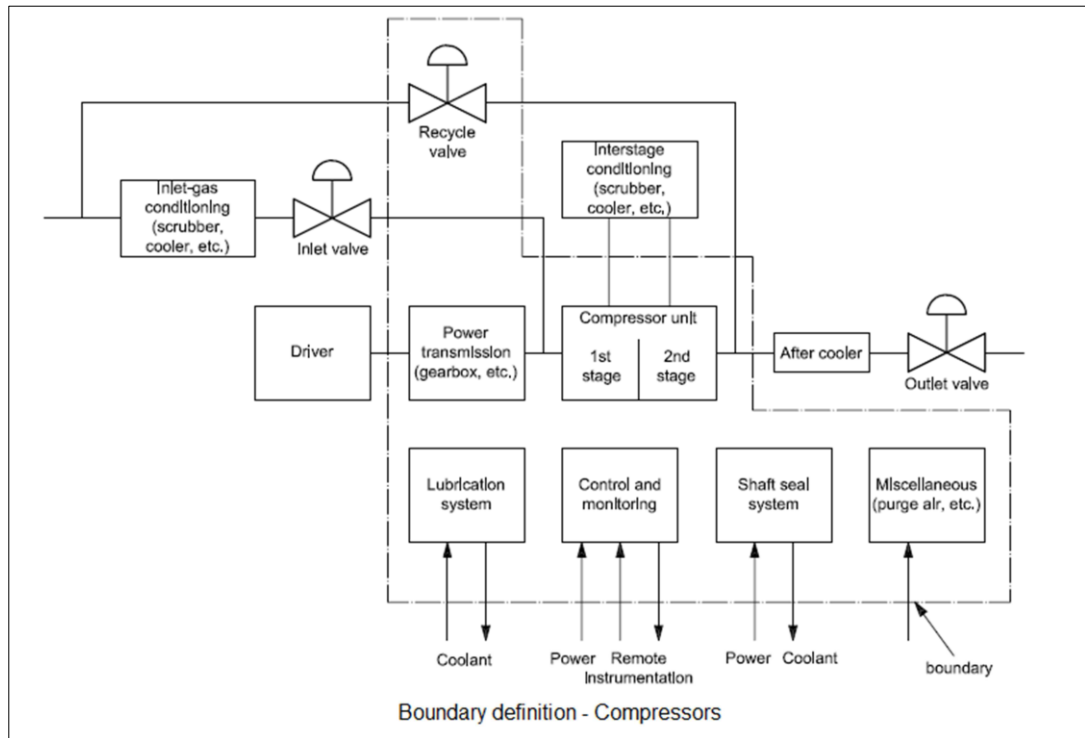


FIGURE 2C

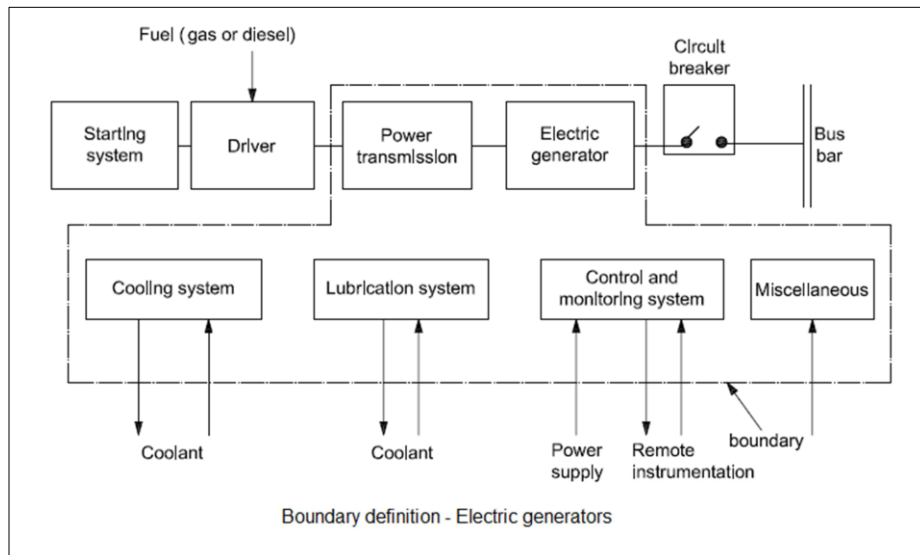


FIGURE 2D

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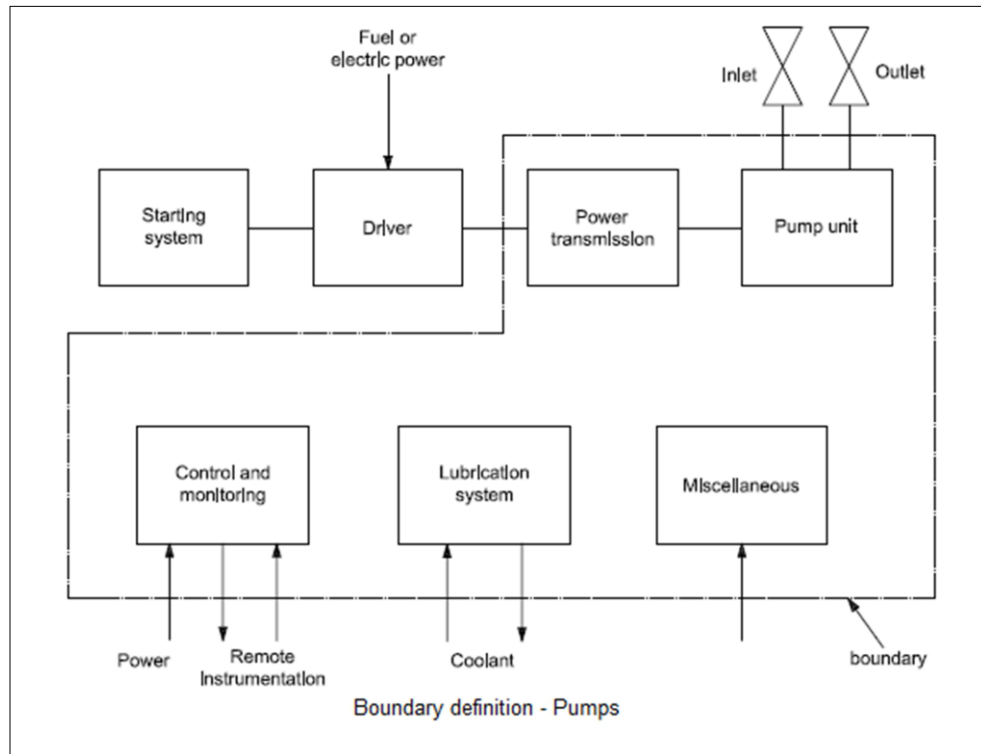


FIGURE 2E

APPENDIX 1 – COUNTABLE FAILURE TABLE

1. Any failure resulted from faulty manufacturing or engineering for main or ancillary equipment, components or systems that demand casing disassembly, realignment, adjustment, replacement or repair of any component.
2. Performance disturbances caused by malfunction of performance/capacity controllers, speed controllers, anti-surge controllers, protection systems, communications devices and interlocking within the package that request re-programming or re-configuration.
3. Any repeated actuation (two consecutive or three non-consecutive events) of the same trip that request re-configuration, recalibration and re-setting of parameters.
4. More than three unsuccessful starts in sequence demanding recalibration and re-setting of startup system.
5. Vibration & bearing temperature levels higher than specified / contracted.
6. Failure to stop on demanding during test sequence.

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General Notes:

- 1- Any external cause (from outside turbomachinery boundaries) that leads to the shutdown shall be disregarded. The test shall continue after restart the turbomachinery unit counting the aggregated time so far.
- 2- Any other occurrence that cause no immediate neither critical impact on the equipment/system function will be considered as typically non-critical failures, and therefore will not interrupt the test (abnormal instrument reading, minimum external leakage, signal transmission with intermittent disconnection, poor response to feedback, false alarm, faulty instrument indication or similar malfunction).
- 3- Any lack off or reduced ability to provide heating/cooling/exhausting/ventilation of auxiliary systems due to external poor sources shall be evaluate in order to not jeopardize the test result. If necessary, the test shall be interrupted up to all external sources are in steady condition.