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RTS℠ - Rexnord Technical Services
Mechanical & Material Engineering Services

Technically Speaking

fa·tigue (fə-tēg')
n.

1. Physical or mental weariness resulting from exertion.
2. Something, such as tiring effort or activity, that causes weariness: the fatigue of a long hike.
3. *Physiology.* The decreased capacity or complete inability of an organism, an organ, or a part to function normally because of excessive stimulation or prolonged exertion.
4. The weakening or failure of a material, such as metal or wood, resulting from prolonged stress.

Source : The American Heritage® Dictionary of the English Language, Fourth Edition

Component Fatigue Testing

Fatigue is a progressive failure of a part under repeated, cyclic, or fluctuating loads.

Unlike pure materials testing, in which engineers are trying to determine material properties for selection in use in a component part, component fatigue testing cyclically stresses a manufactured component. The engineer may be evaluating a new, less costly manufacturing process to determine the effect on the useful life of the component, or evaluating different materials for use in the component, or evaluating the effect of a design change on the life of a component. With the advent of computerized fatigue life prediction software, fatigue testing is also performed to validate the results of Finite Element Analysis (FEA) models.

It is always best to perform this type of testing with some knowledge of the loads encountered in actual use. To try to duplicate these loads, components are sometimes strain gaged and placed in use in their normal operating

environment. The test equipment that controls the process is then programmed to closely duplicate the loads that produce the strains encountered in actual use. One such system is marketed by MTS™under the trade name RPC™ (Remote Parameter Control).

If the product being tested encounters temperature or humidity extremes in actual use, environmental chambers are used to simulate these conditions.

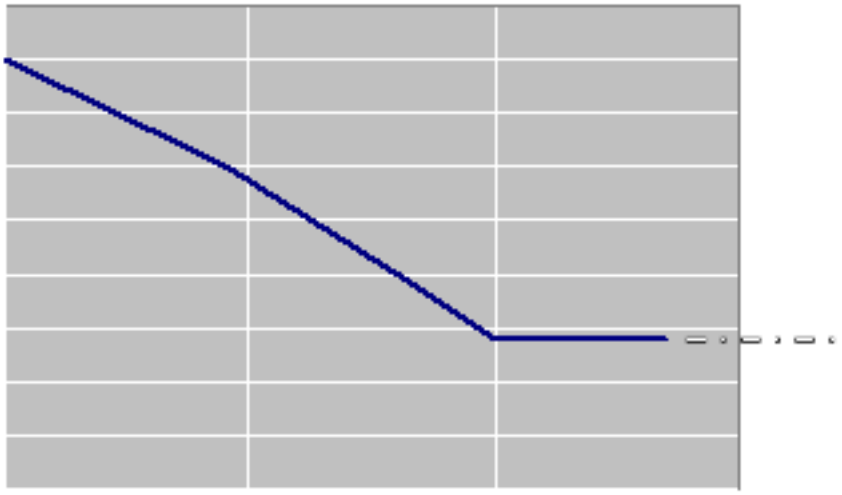
RTS has developed some expertise in the fatigue testing of axles used on off-road machinery. Other items that are routinely tested at RTS include connecting rods, crankshafts, roller chain and engineered chain.

Since all products are different, RTS has become adept at building specialized fixtures for product fatigue testing.

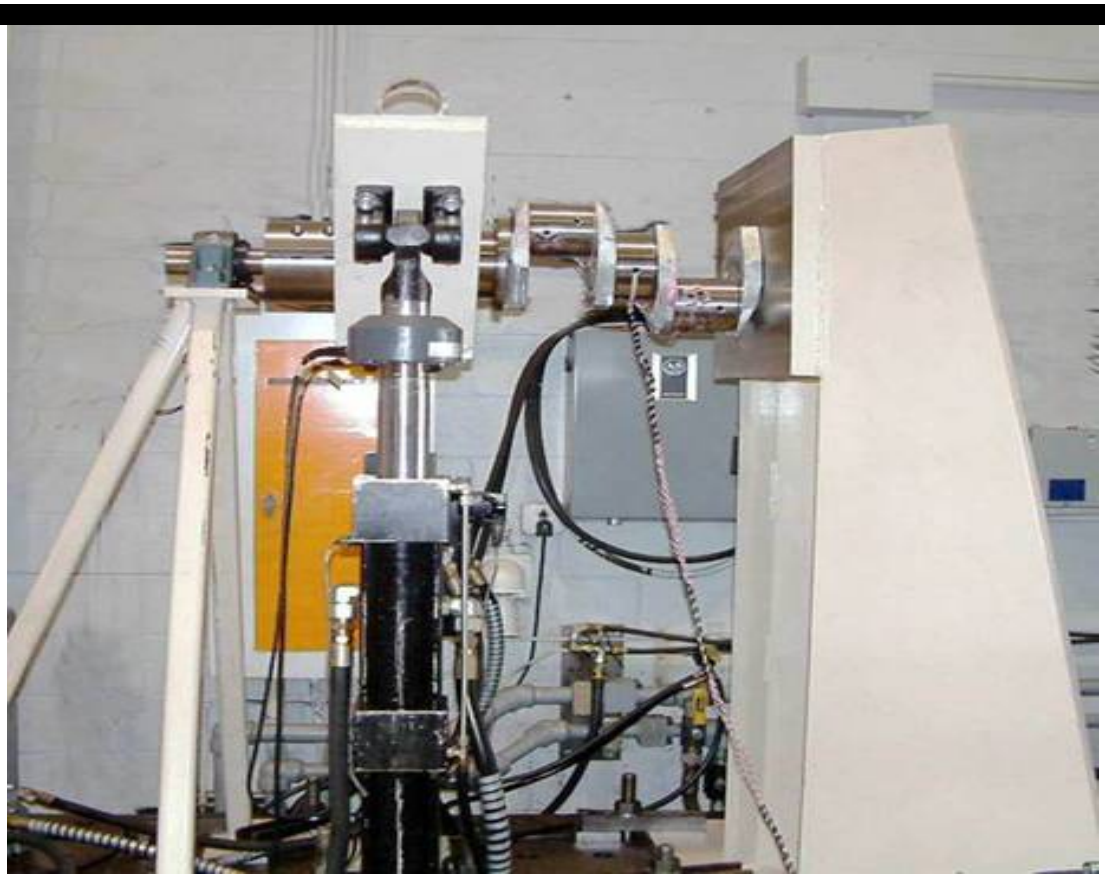
Fatigue tests can be performed in a variety of modes. One of the modes is termed “full reverse” or tension/compression testing. The controller is programmed to generate a sinusoidal load curve, such that a maximum specified load is applied with an equal and opposite amplitude. Occasionally, testing is done in a “half reverse” or tension/tension mode. The load is always in tension between some small load and a maximum specified load.

Tests can be performed either on a test bed or on a load frame. Where the test is set up depends on the size of the pieces being tested, fixture requirements, and test requirements. RTS has a number of test beds that can be used, depending on the size of the component.

If the product under test is of relatively small size, and the test is relatively simple, tests can be done on a load frame. The test setup consists of a load frame in which are mounted an upper and lower grip for holding the sample, a fatigue rated load cell for measuring loads, and a hydraulic cylinder to apply load, displacement, or strain. Product fatigue testing can be performed in either load, strain or stroke control. They are most often done in a load control mode or a strain control mode. Connected to the load cell is a controller to control the hydraulic cylinder based on feedback from these devices. The end result of a product fatigue test is usually a load vs. number of cycles to failure graph, or a stress vs. number of cycles to failure graph. In order to fill in the curve, a statistical number of samples needs to be tested at various load conditions.



If the product has never been tested before, the initial run is a trial and error procedure to try to determine a reasonable range over which to test. At low loads for the particular material being tested, the L-N/S-N curve approaches an asymptote at which, in theory, no failure occurs at an extremely high number of cycles. The number of cycles at which this occurs is termed runout, and is either specified by the person requesting the testing or determined by reducing the load or strain until there is a portion of the curve that is horizontal i.e, decreasing the load or strain no longer results in a finite in number of cycles. The load at which this occurs is termed the fatigue limit. In theory, if operated below the fatigue limit, the product will have an infinite life.



RTS Capabilities

RTS uses multiple hydraulic systems that generate a maximum pressure of 3000 psi, and a total pump capacity of 165 gpm. The hydraulics to run a test are available on a manifold that has connection points for inflow and outflow at various locations within the various test labs.

RTS has the following equipment available for product fatigue testing:

Multiple closed loops, servohydraulic load frames with load, stroke, or strain control.

- Fifteen load frames ranging from 3,000 to 200,000 pound capacity

- Four spectrum controlled bearing testers ranging from 20,000 to 100,000 pound capacity

- Multiple controllers and actuators ranging from 1,000 to 100,000 pound capacity to perform unique tests requiring bedplate space.

Thirty-two channels of Real-Time active control:
Arbitrary and/or Block Cycle wave form generation

Universal High Speed Dynamic Testers
Mechanical load controller fatigue testers operating at 30 Hz.

- One 4,000 pound
- One 40,000 pound
- One 200,000 pound

Thermomechanical Test Equipment

Hot/Wet/Cold chambers for universal testers

Specialized Testers

Over 25 specially built mechanical testers to evaluate components including chains, industrial bearings, couplings, airframe bearings, and others.

One (1) Thermolyne environmental chamber 22" x 14" x 16". There are holes at the top and bottom for actuators. The holes are approximately 4" in diameter and have centers 9.5" from the front of the chamber. The controller for this chamber can maintain temperatures to ±3 ° F. The upper temperature limit is approximately 300 ° F. Low temperatures are maintained by the adiabatic expansion of gases The lower limit is determined by the gas that is used.

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A little knowledge that acts
is worth infinitely more than much knowledge that is idle.

-Kahlil Gibran

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