

Eng. Sarath Gamini, Project Director
Eng. H.M. Nimal Jayantha, Consultant Engineer

ABSTRACT

The aim of this paper is to discuss the importance of endurance test on maintaining performance of a product at its initial performance level. The performance of a product is deteriorated with aging so that determination of performance behavior i.e. endurance test of the product over its life time is crucial in making conformity of product quality by the manufacturer or user. Today, most of the water-work products used in water supply and distribution systems in the country fail to perform its intended duty over their life time or prior to reach acceptable operational time period. Such products are the major contributor of present water losses of about 35% experienced in potable water distribution system maintained by NWSDB. By recognizing this situation, NWSDB has now initiated the quality assurance programme in which pre-qualification of the products prior to importation is the initial and main activity. Product pre-qualification is a long process starting from product standardization and ending up with declaration of the product as the control item.

Importance of Endurance Test of Water-Work Products

(Note: Definition of Water-Work Products: Pipes and their fittings and, equipment/ appliances in water lifting and distribution systems)

Background:

The objective of conducting an endurance test is to find out fitness of any product on delivering its intended duty over the specified life time. Although the solid data base of water work products used in the country is not available presently in the National Water Supply and Drainage Board (NWSDB) or any other institutions, it is a very clear fact that the most of water-work products are not able to deliver their intended duty (performance) over their specified life time. The main reason behind it, is the inferior quality of those products. It has also been revealed that the products of inferior quality is the major contributor of present water losses of about 35% experienced in potable water distribution system maintained by the NWSDB. Some of them fail even in initial stage while others deteriorate their performance along with aging before reaching the specified life time. Initial stage failures are mainly due to mismatching physical parameters (size, weight) and compositions of materials whereas deteriorating performance is due to degrading and, excessive wear and tear of material or fatigue by cyclic load experience in aging. Properties of material used in water-work products therefore become a very crucial issue in quality assurance. By recognizing this situation the National Water Supply and Drainage Board (NWSDB) has now initiated action to launch quality assurance programme of which pre-qualification of the products prior to importation is the main activity. It is no doubt that pre-qualification of the products prior to importation can reduce water losses of supply and distribution systems significantly because more than 95% of water-work products are presently being imported to the country. Product pre-qualification is a long process starting from product standardization and ending up with declaration of the product as the control item by the government. It needs an accurate database of

imports of water-work products and their quality. Quality should be recorded in two stages.

- Initially product must perform satisfactorily.

Measuring indicators i.e. performance parameters will have to be specified in standards. This could be done by a series of performance tests conducted in a controlled environment.

- Secondly product should not deteriorate its initial performance along with aging

This could be done by endurance test carried out in actual field or with help of a simulating model to field performance of the product.

What is Performance test?

The performance of the product is not confined only to the desired output. There are other parameters which are linked with intended output such as leakage through the body, dissolving material of components in water, load bearing capacity, safety on operation etc. It is therefore necessary to quantify the desired output within specified accuracy while other parameters are being maintained at satisfactory level. When all those parameters are put together only it becomes a complete set of specifications of the particular product which is essentially required for procurement.

These specifications are measured and evaluated in two stages. Firstly when the product is being manufactured and secondly when the product is offered to the market. There are series of test to be conducted to evaluate performance parameters as follows.

1. Outputs as specified in standards or relevant specifications
2. Leakages through the body as well as flow path
3. Properties of material required to withstand static, dynamic and cyclic load during operation
4. Composition of materials in contact with water
5. Safety

THEME 4

What is Endurance Test?

Endurance test, also named as durability test is not the one which is going to find out breakage level or bursting point or, the level at which the product achieves permanent deformation. All those are destructive tests which are also a type of performance tests. The endurance test is the operating model for aging the product which is able to indicate the failure level on initial level of performance of the product. In addition the endurance test is essential to analyze how the product behaves in the system over its life time. By putting all these together, more accurately, the endurance test is a kind of test to evaluate the performance on specified parameters while it is performing its intended duty over its desired life time. Its performance is therefore has to be tested and evaluated against potential parameters while the product is under operation. Some of common parameters in endurance tests are as follows.

1. Cyclic loads which affects on strength
2. Rubbing action which affects on wear and tear
3. Material dissolving in water at dynamic and static condition which contaminate the water
4. Degrading material which affects on strength

Endurance test is essentially incorporated with performance evaluation tests otherwise end result of the endurance test could not be observed and quantified. In addition, endurance test should be followed by statistical analysis to compute and estimate their life time, risk factors and replacement time of the particular item together with important information such as type of failures and their probability. This is the data base which is needed for pre-qualifying process of products.

Example:

If the endurance test can identify the limit of wear at which the performance will not be within the specified/intended values, it can be evaluated whether it is worthwhile to repair or replace in order to keep in desired operation level.

In some cases there are arguments to develop two types of tests, naming reliability test and durability test, within endurance test. But this argument is disqualified because there are no different standard tests procedures and methods defined separately based on those two arguments. Reliability is the mathematical models developed on the base of statistical data gathered during the endurance (durability) test. Reasonable definition of the "Reliability" is "the estimate of unanticipated interruption of operation of plant and equipment". The unanticipated interruptions typically arise from unexpected failures.

Methods of endurance tests:

There are several methods of conducting endurance tests.

1. Field test:

Product or product fixed in the system is operated in actual condition for long period and performance will be tested at specified time intervals. This is a time-consuming and expensive method. But it is possible to obtain accurate data as it is working in actual conditions.

2. Laboratory accelerated tests:

The product is operated in laboratory by simulating a model in which operations are accelerated. This is less time consuming, but expensive method.

e.g. If the field operation is cyclic the laboratory test will be conducted by a machine at high frequency of cyclic operation.

At present, two test apparatus, stop cock test apparatus and ball float control valve test apparatus, are already being used at the laboratory established under the Central Region of NWSDB. The test-rig for testing of water meters will be installed at the same laboratory very soon. Wet-well testing unit is also under construction of which bulk meters and large valves will be tested. With all these facilities NWSDB can handle all types of tests required for water-work products

In both cases the test procedures and methods should be complied with accepted standards enforced by relevant authorities. These procedures and methods are developed by taking account of material, performance and process requirements specified in the product standards and, health and safety requirements according to rules and regulations enforced by authorized bodies (e.g. internationally WHO, Water Regulations Advisory Scheme (WRAS), National Sanitation Foundation (NSF) etc).

Importance of the endurance test:

Endurance test is appearing in two stages in a product life cycle.

Firstly, endurance testing is an essential element in R & D on product development. This is the only way to identify and fix the value of parameters in maintaining a consistent level of quality of the product over its service life. As an example the data acquired by intensive endurance test during R & D process reveals the potential areas where wear and tear can occur.

Secondly, when the product is offered to the service the clients need to know its service life and, replaceable parts and their replacing time. Conducting endurance test and its data analyzing is the only

way to estimate failures modes. Then taking prior action on expected/predicted failures the desired function of the product or the system can be obtained continuously without interruption. The endurance test is also required to evaluate the performance behavior of the product in different working environment.

In both these situations, an endurance test is required. Once the endurance test is conducted the test report will be issued indicating its suitability (fitness) for the circumstances in which it is used. As an example all water-work products are subjected to cyclic pressure variation with adverse water hammer vibration. They are also exposed to different water conditions in over ground and below ground installations. To determine how the product will work in such adverse conditions, observations and evaluation based on data obtained by endurance test is very essential.

Services of NWSDB:

By recognizing the importance of the endurance test of the water-work products, the testing laboratory in the Central Region of NWSDB has been established and following services are offered.

1. GKWSP will test the product and will issue the test certificate indicating its suitability in the circumstance in which it is supposed to be used.
2. GKWSP will also offer the services for resolving the dispute in any case of disagreement between suppliers/manufactures and customers or any other parties.

With this achievement it is no doubt that all parties, suppliers and users, are benefitted as the quality products minimize the dispute among them and eliminate water losses as well as maintenance cost.

Endurance test conducted at Water Fitting Testing Laboratory (WFTL) of GKWSP

1. Float operated valve test apparatus:

This apparatus has been designed to make cyclic on/off operation occurred by responding variation of water level and run the system for set number of cycles. At the end of the test the valve will be tested for its current performance level.



Figure 01: Float control valve test apparatus

2. Stop valve test apparatus:

This apparatus has been designed to make cyclic on/off operation by turning the stem of the valve while pumping water flow through the valve and run the system for set number of cycles. At the end of the test the valve will be tested for its current performance level.



Figure 02: Stop cock test apparatus

3. Water meter endurance test apparatus:

This apparatus has been designed to make cyclic on/off operation by allowing water flow through test meters and run the system for set number of cycles. At the end of the test the meter will be tested for its current performance level.

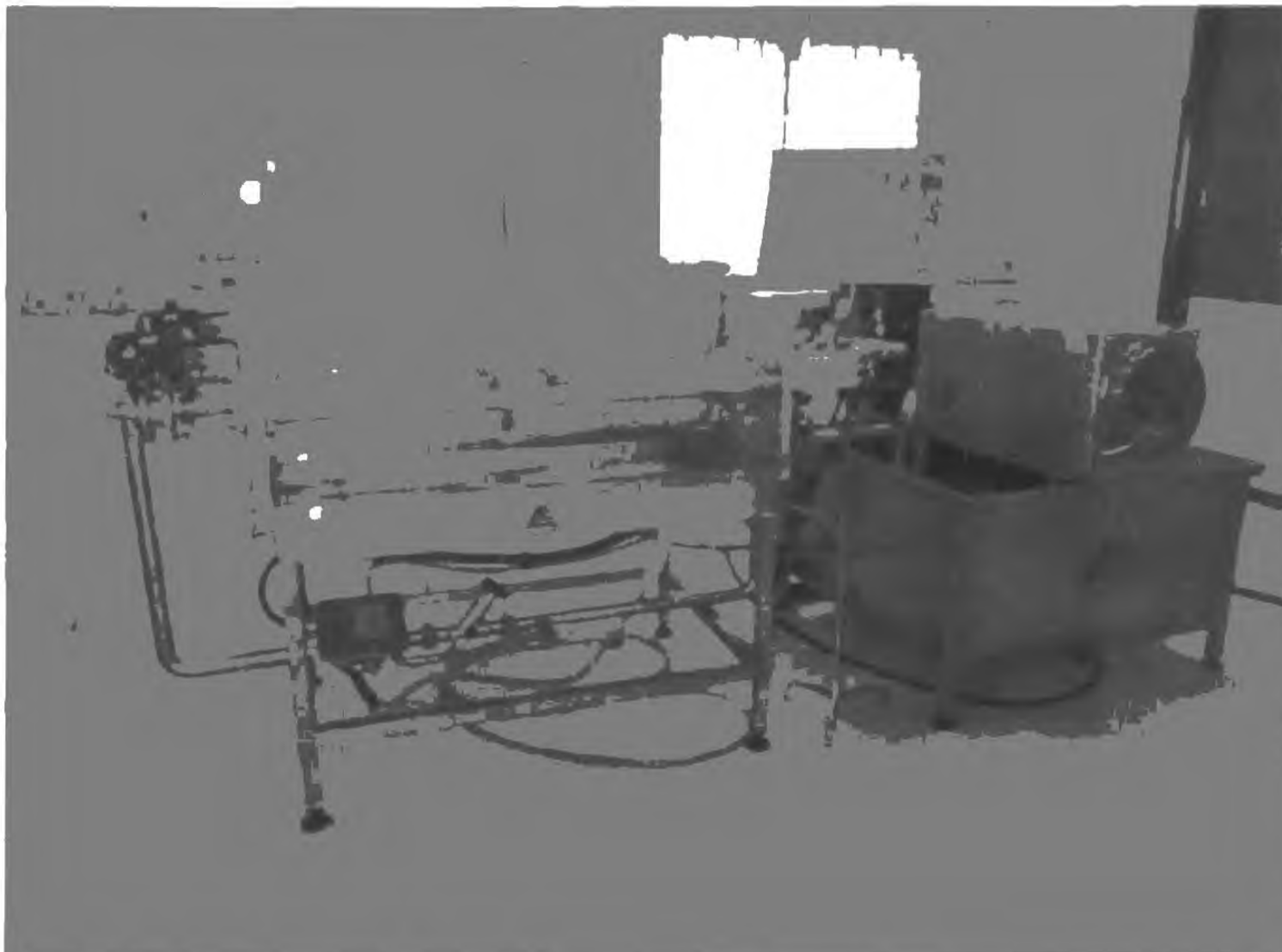


Figure 03: Water meter endurance test apparatus



Figure 04: Water meter intrinsic error test apparatus

Epilogue

Need of quality assurance programme for water-work products has now become important as the inferior quality of water-work products contribute highest portion to present water losses in pipe borne water in the country. Further, the endurance test is one of essential elements in quality assurance process of water-work products.