Babcock & Wilcox

a McDermott company

Condition Assessment Services

Put our team of specialists to work for you

HEADERS

Don't let a steam leak be your first sign of header problems

Figure 1: Photo of header where metal was removed by the washing action of steam leaks — a result of undetected ligament cracks.

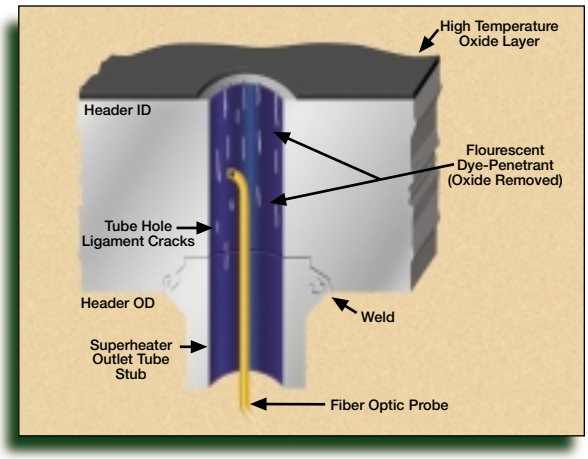

Figure 2: Diagram of tube bore hole exam with the high temperature oxide layer removed.

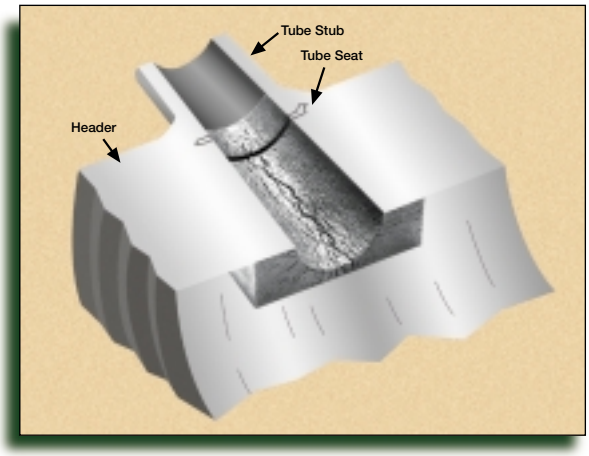

Figure 3: Cracking in economizer inlet header occurs first in bore holes nearest water inlet.

High Temperature Headers

High temperature superheater and reheater headers that operate at temperatures above 900ºF (482ºC) are subject to long term damage due to creep and creep-fatigue. Your predictive maintenance programs must include these high temperature headers. Otherwise, your first indication of problems could be tube stub weld leaks (figure 1). Babcock & Wilcox (B&W) has been a leader in the assessment of superheater and reheater headers since the problems of ligament cracking first appeared in the early 1980s. We have assessed the condition of hundreds of high temperature headers —many nearing the end of useful life.

Hone & Glow® inspection finds ligament cracks

B&W developed the patented (U.S. Patent 4,682,397) Hone & Glow test to detect ligament cracking in the header bore holes. Ligament cracking is attributed to oxide notching and creep-fatigue damage mechanisms. Initially these cracks can appear as very shallow, broad indications along the bore hole. Early detection requires removal of oxide scales without removal of the cracks themselves. The Hone & Glow test effectively finds early stage bore hole cracks (figure 2). For more information, ask for PS-239.

Other services

In addition to our Hone & Glow test, we have the experienced personnel to provide complimentary test services to fully assess your headers, including: magnetic particle testing, dye penetrant testing, replication, internal video probe examination, ultrasonic shear wave and thickness testing, as well as the engineering expertise to calculate the remaining life of your headers. For more information on replication, ask for PS-251.

Low Temperature Headers can also fail prematurely

Low temperature headers are not immune to damage or failure, even early in their lifetime. Today, electric utilities are forced to cycle many of their boilers. Cycling service is much more severe than constant load operation. Often, boilers designed for a few cycles per year are cycled weekly or even daily. During on/off cycling, thermal shock can occur in the economizer inlet header. In one instance, an economizer inlet header had to be replaced after just seven years of service because of cracking caused by thermal fatigue (figure 3).

We can put our extensive knowledge and boiler design experience to work for you to ensure all critical headers are included in your life assessment program. We will help you inspect the headers to determine if damage is present. We can assist you with obtaining and analyzing operating data to predict the potential for future damage, and, if needed, we can offer modifications to reduce or eliminate the problems caused by cycling service. For more information on cycling related boiler problems, ask for PS-254.

ENGINEERING and TESTING SERVICES

Figure 11: B&W's valve testing service can quickly detect even the slightest seat leakage with high accuracy.

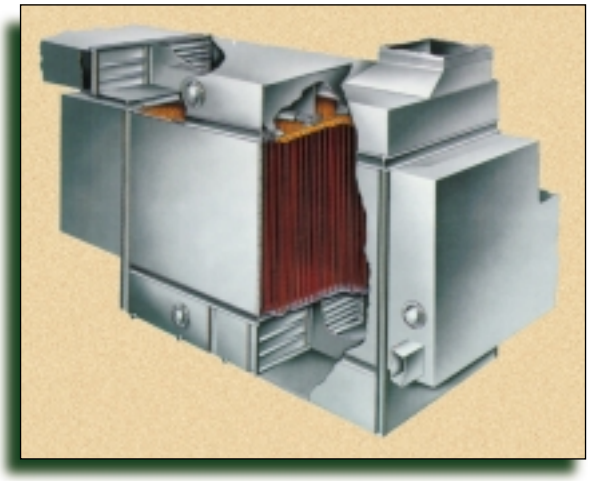

Figure 12: Plugged and leaking tubes (area in red) are the major problems leading to inefficient operation and increased maintenance costs in tubular air heaters.

Figure 13: Boiler fitness surveys include a thorough inspection of your boiler to identify opportunities for improved performance.

Ignoring your valves can be costly

Both industrial and utility plants have hundreds of valves that must be maintained or periodically replaced. Valve maintenance can be costly. However, lack of valve maintenance can be just as costly because of lost heat and efficiency. B&W offers a cost effective **Valve Leak Detection** service that optimizes your valve maintenance program. You can avoid maintenance to valves that are not leaking, and more importantly, you will know which valves to replace first based on the severity of the leaks. Our valve leak detection service uses a portable test instrument so that testing is fast — more than 50 valves can be tested in a single shift (figure 11). Our test only requires access to the valve stem, so expensive insulation removal is not needed. And since we have tested over 5,000 valves, the test has a proven record of accuracy and reliability. For more information on B&W's valve leak detection, ask for PS-360.

Leaking air heater tubes can be quickly detected

Large tubular air heaters have thousands of tubes. Erosion and corrosion can lead to tube thinning, holes and leakage (figure 12). This leads to reduced efficiency, an increase in FD fan load to meet combustion air flow requirements, and an increase in ID fan power due to the increased loading from the air heater. All of these losses in efficiency and power cost you money. **The Acoustic Ranger®** test is offered by B&W to help you find leaking and plugged air heater tubing. The Acoustic Ranger utilizes acoustic technology and depending upon air heater conditions, several thousand tubes can be tested in a single shift. For more information, ask for PS-365.

Boiler fitness survey provides a comprehensive assessment

Drawing on the experience of our field engineers (figure 13), B&W provides a complete assessment of the entire boiler in the boiler fitness survey. We work with you to determine the critical components in your boiler and tailor an assessment program to your needs. Since we have performed surveys on boilers throughout the world, we have the knowledge to help you plan your testing and inspections for the most cost effective program.

Condition Assessment Services are just part of the specialized offerings of B&W Field Engineering Services

In addition to the many specialized assessment services, Babcock & Wilcox Service Specialists® consulting is available to assist you with water chemistry and boiler chemical cleaning, structural evaluations, air heater inspection and maintenance, and the operation and maintenance of your coal pulverizers. We have a worldwide network of Field Service Engineers providing the experienced technical support you need — whether your boiler was designed by B&W or any other manufacturer. Our Field Service Engineers offer an array of solutions tailored to your needs. The field managed contract, executed from your local district service office, has demonstrated the flexibility oftentimes needed to provide the unique solution to your specific problem in a timely manner. For more information, ask for E101-3113.

PIPING

Piping Assessment is Critical

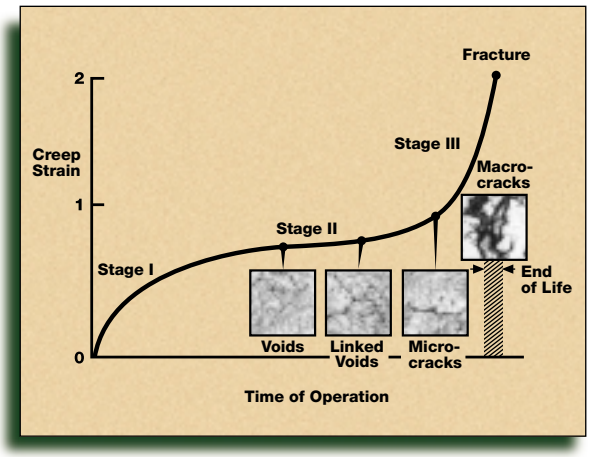

Figure 4: Progression of creep damage over time as depicted by replica photomicrographs.

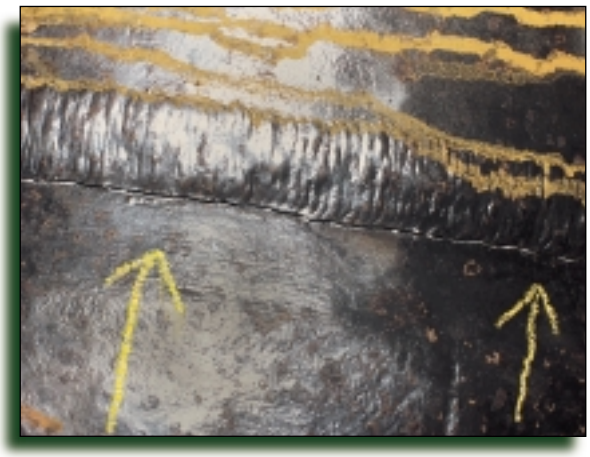

Figure 5: Circumferential crack found in hot reheat superheater steam line.

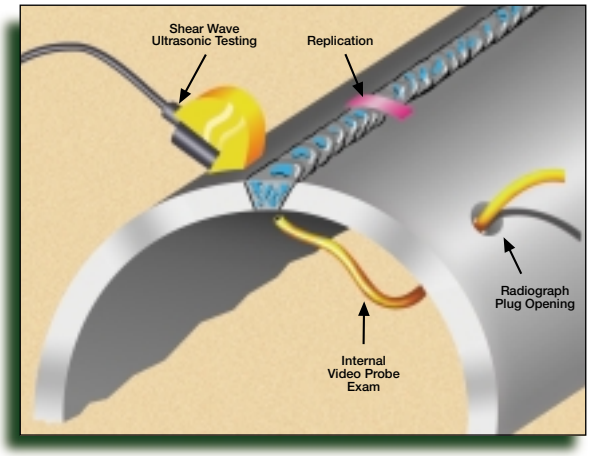

Figure 6: Locating cracks in rolled and welded steam piping nondestructively.

Main Steam and Hot Reheat Piping

In 1985 and 1986, two hot reheat pipes failed catastrophically. The pipes were only about fifteen years old when they failed. These failures illustrate the effects of creep (figure 4) in low alloy materials operating at high temperature. Given enough time in operation, damage will develop due to material creep as well as thermal fatigue (figure 5). It is clear that condition assessment programs must include a thorough examination of both the hot reheat piping and the main steam piping. B&W played a key role in developing the analytical software used to assess damage in headers and piping. We can assist you in tailoring a piping assessment program to your needs.

Our service personnel will do a system review which includes a walk-down inspection of the piping system and supports in both the hot and cold positions. Critical information from the walk-down can then be input to the piping load or flexibility analysis to determine the critical weld locations. Our condition assessment field specialists will provide on-site expertise to ensure inspections and testing (table 1) are performed correctly so that reliable data is used for the assessment. Most importantly, we have the personnel and calibration standards to ensure that volumetric ultrasonic weld inspections are done correctly, whether to ASME or EPRI guidelines. B&W, as a full scope supplier, can provide support labor for access, surface preparation and repairs, as needed. For more information on piping condition assessment programs, ask for PS-250.

Feedwater Piping

Sometimes overlooked, feedwater piping is an important part of critical piping systems in both utility and industrial plants. As recently as 1995, a catastrophic feedwater pipe failure resulted in serious injuries and fatalities. Damage in feedwater piping is attributed to various factors, but the most severe damage is associated with flow accelerated corrosion (FAC). FAC leads to accelerated wall loss which can occur over a relatively large area. As a result, failure can be catastrophic and lead to the escape of a large volume of hot (300ºF, 149ºC) water into the plant.

B&W can help you determine the critical locations in your feedwater piping that are most susceptible to FAC. Our field personnel can then support an assessment program including nondestructive testing to verify material integrity. For more information, ask for plant service bulletin PSB-47.

- Dimensional measurements
- Limited access remote visual inspections
- Dye penetrant testing (PT)
- Magnetic particle testing (MT)
- Replication
- Shear wave and longitudinal wave ultrasonic testing
- Material verification

Table 1: Examinations used for main steam and hot reheat piping.

TUBING

Is time running out on your tubing?

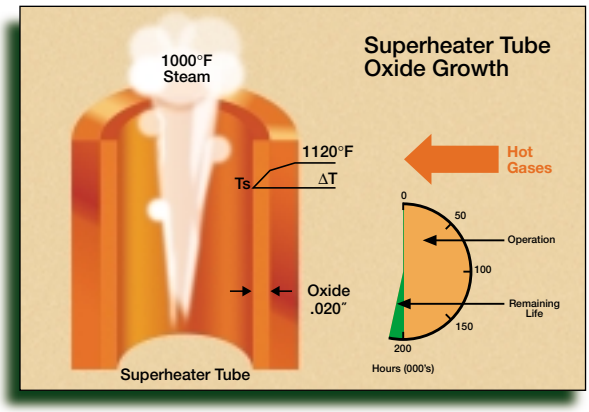

Figure 7: Steam side oxide scale on tube ID increases tube metal temperature and reduces tube life.

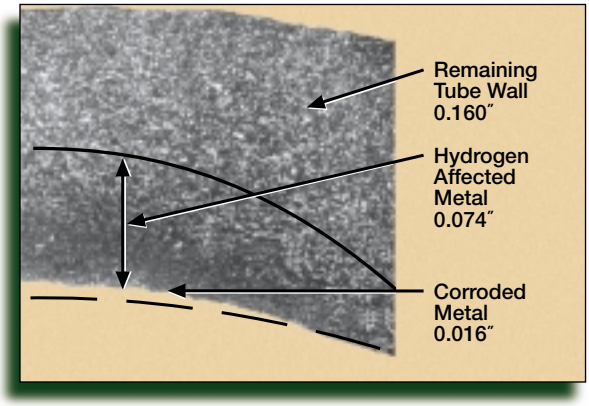

Figure 8: Hydrogen damage extends beyond corroded area weakening tubes.

Figure 9: The exceptional testing speed of the FST-GAGE™ allows B&W technicians to scan thousands of feet of boiler tubing.

Figure 10: Corrosion fatigue cracks in membraned wall tubes.

Tubing failures continue to be the leading cause of forced outages in fossil fuel fired boilers. It stands to reason that any condition assessment program must include evaluation of the tubing.

Superheater and Reheater Tubes - Creep

Just as with high temperature headers and piping systems, alloy tubing in the superheater and reheater experience creep during normal long term operation which eventually leads to creep-rupture failure. Oxide scale builds up on the inside diameter (ID) surface and has an insulating effect raising tube temperatures (figure 7). At the same time, tubes can experience wall loss from corrosion and erosion leading to increased tube stresses.

B&W developed the **NOTIS®** test to evaluate the remaining creep life of superheater and reheater tubing. NOTIS measures both the tube wall and the ID oxide scale thickness nondestructively. This data coupled with B&W creep-rupture databases is used in the NOTIS computer program to calculate remaining life. NOTIS has been used to evaluate more than 350 superheaters and has proven its value to life assessment programs. For more details on NOTIS®, ask for PS-257.

Other tube damage

In addition to creep damage, superheater and reheater tubes are subject to other damage mechanisms. Given certain conditions, damage such as high temperature oxidation and fuel ash corrosion can occur on superheater or reheater tubes operating at high metal temperatures. In addition, convection pass tubes including generating bank and economizer tubes can experience external erosion and corrosion. For units out of service, oxygen pitting can be a concern. All of these damage mechanisms lead to tube wall thinning. B&W developed the **MANTIS®** service, utilizing automated ultrasonic thickness data storage and computer-based data management for complete mapping of tubes to easily evaluate thinning trends. For more information on MANTIS®, ask for PS-240.

Water Wall Tubes

Tube wall loss from corrosion or erosion can also occur on water wall tubes and MANTIS is an effective test for mapping thickness. However, unique problems can occur in water wall tubes leading to damage that can be difficult to detect. Boilers that are due for a chemical cleaning to remove internal deposits are prone to accelerated internal corrosion. Under-deposit corrosion can lead to caustic corrosion (high pH conditions) or hydrogen damage (low pH acidic conditions - figure 8). In either case, identifying and isolating the damaged tubes can be very difficult. B&W developed **FHyNES®**, an ultrasonic test (UT) to more rapidly scan for hydrogen damaged tubes.

More recently, working with the Electric Power Research Institute, we developed a new test based on electromagnetic acoustic transducer technology called the **FST-GAGE™**. Our FST-GAGE test scans tubes to find corrosion or hydrogen damage many times faster than UT based tests (figure 9). Corrosion fatigue, another "hidden" problem attributed to corrosion in combination with thermal cycling, also can be found in many older boilers (figure 10). More recently we have developed special probes for the FST-GAGE test which can detect certain types of corrosion fatigue damage. For a more detailed discussion of tube failure mechanisms, ask for E101-3153. For information on the B&W FST-GAGE™ test service, ask for PS-368.

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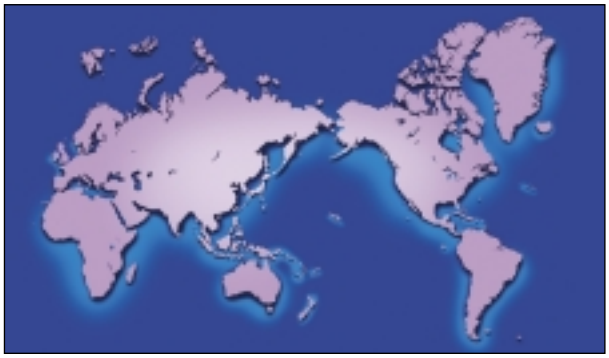

Powering the World Through Teamwork and Innovation℠

While others may use the Babcock name, we are the ***original*** *Babcock & Wilcox with more than 130 years experience in engineering, constructing and servicing steam generating systems. Insist on us by name.*

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