# History of SATEC™

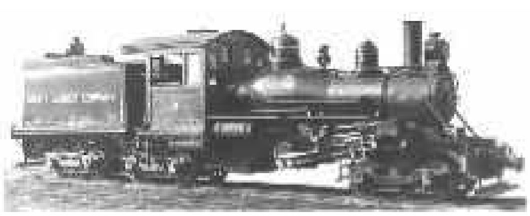
A Rich History of Materials Testing Equipment

## Late 1800s

In 1831, Matthias Baldwin founded Baldwin Locomotive Works in Philadelphia, Pennsylvania.

THE BALDWIN LOCOMOTIVE WORKS
BALDWIN SOUTHWARK DIVISION
PHILADELPHIA

In the late 1800s, Baldwin Locomotive Works began to design and develop their own high capacity testing machines in order to test large metal castings produced for their steam locomotive business. Initially these machines were used to determine only the ultimate breaking strength. They had a single range pressure tube indicator to measure and show the applied force.



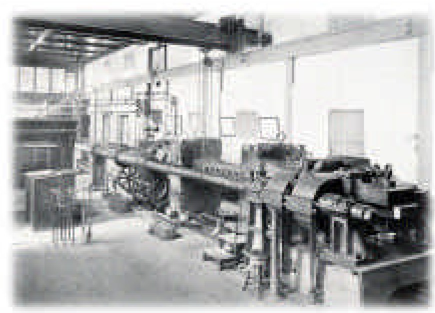
▲
The first Baldwin testing machines were designed to test castings for Baldwin's locomotives

▲
Baldwin Locomotive Works was located in Eddystone, Pennsylvania

## 1930s

In the 1930s Baldwin-Southwark Corporation worked with materials testing innovators such as A.H. Emery and Frank Tatnall to develop and grow their testing machine business.

▲
Frank G. Tatnall with later model SR-4 testing machine



▲
A.H. Emery's world-famous "United States testing machine" was installed in 1879. Capacity: 800,000 lbf (tension); 1,000,000 lbf (compression).

The Baldwin-Southwark Corporation officially partnered with these testing specialists to produce the Southwark-Emery line of machines. Later, they were joined by Tate and changed the name to Southwark-Tate-Emery.

Southwark
TATE • EMERY

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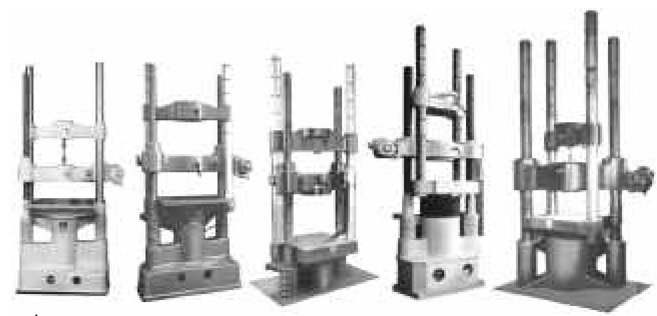
# History of SATEC™ (continued)

Even Thomas Edison used a Southwark testing frame in his laboratory.

▲ Thomas Edison's Southwark press is on display at the Henry Ford Museum



▲ Southwark-Tate-Emery, BTE series

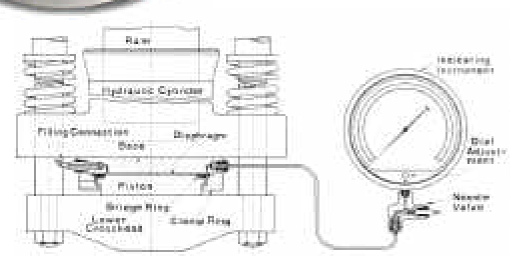
The Southwark-Tate-Emery line used hydraulic fluid to apply and measure testing loads. The load measurement system was independent of the load application system and used the unique Emery load weighing capsule. The company's tagline was "The trend is definitely to the all-hydraulic machine."

The principal product of the company was the static hydraulic BTE series (an acronym for the founders' last names, Baldwin, Tate and Emery). These frames were available in five standard models ranging in capacity from 60,000 lbf to 400,000 lbf. This line is the predecessor of the modern day 5590-HVL series and DX series.

In addition to the BTE series, the Southwark-Tate-Emery line included static hydraulic compression testers, torsion testers and spring testers. Similar products are still manufactured nearly 100 years later.

◀ Emery load weighing capsule

Emery capsule configuration ▼




▲ 90,000 lbf Southwark-Emery (compression only) cement testing machine

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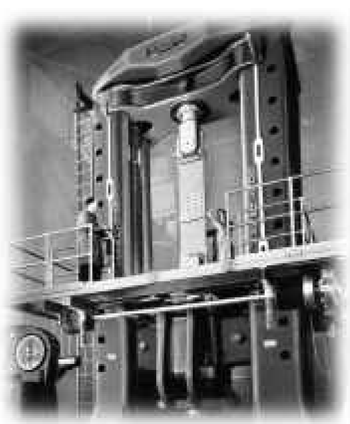
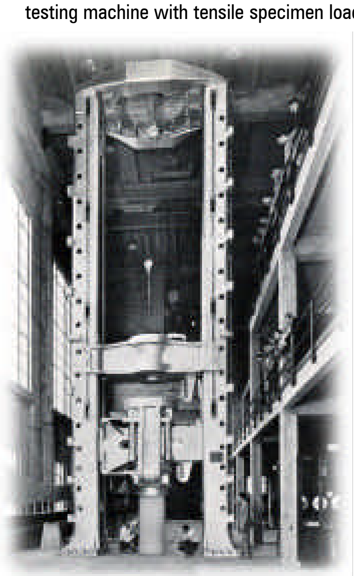
# History of SATEC™ (continued)

Perhaps the most amazing accomplishment of the Southwark-Tate-Emery group was the sheer size of their custom frames. Some systems were designed to apply forces up to 12 million pounds and stood five stories tall. These unique systems were literally cast and built on site. In some cases, the buildings were designed around the frames.

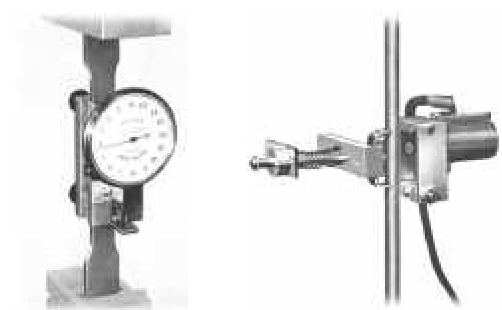


▲
3,000,000 lbf Southwark-Tate-Emery universal testing machine with tensile specimen loaded



▲
4,000,000 lbf Southwark-Emery universal testing machine configured for concrete compression testing

Due to the material requirements of World War II, many advances were made in the testing arena including multiple range load indicators and dial type strain measuring instruments. Additionally, instruments were designed to record strain using microformer LVDT devices.



▲
Specimen strain is indicated with a dial (left) and recorded with a microformer (right)

At first, mechanical drives were used for load, and later the same microformer LVDTs were added to pressure tubes and used as a load recording system capable of producing XY plots of load versus deformation. This was probably the biggest single instrumentation advancement in over fifty years.

▲
Load versus deformation graphs were made possible with the addition of XY recorders (right of dial)

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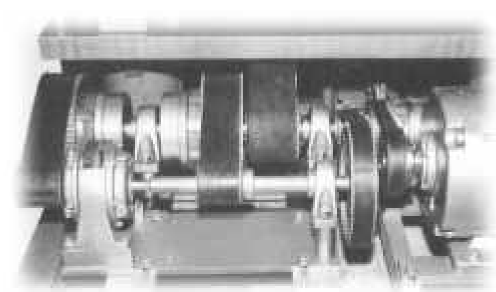
# History of SATEC™ (continued)

## 1940s

By the late 1940s strain gauge technology advanced to a point where load cells were added to Baldwin's electromechanical screw driven frames. Vacuum tube amplifiers and signal conditioning systems enabled the use of electronic load indicating systems. These were the first 'all electric' systems with electrical motor drives, electric load, and strain measuring with an electrical mechanical dial and/ or recorder.



▲ Electromechanical drive system

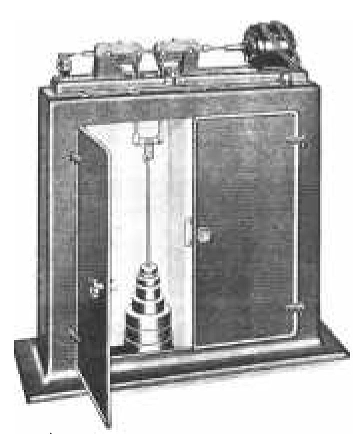
Machine control to this point was manual. Loading rates were sometimes indicated to the operator by mechanical load pacing, strain pacing or ram speed indicators. The electromechanical frames enabled changes in speed through clutch selection switches and later manually operated variable speed motors. Repeated loading, in addition to ultimate loading, became a standard means of testing in the late 40s.

▲ Control module showing selectable speeds

The Sonntag fatigue and IVY mechanical fatigue machines were developed during this decade. The oscillator style machines really became the first load control devices. The feedback to the control was position; as position or displacement increased, the 'static force' controller would adjust the preload to maintain static load.

▲ Sonntag fatigue machine with tension/ compression fixtures

Rotary mechanical fatigue machines were another version of this repeated loading manner of testing.



▲ R.R. Moore rotating beam machine

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# History of SATEC™ (continued)

## 1950s

Real time machine control was advanced in the 1950s with variable speed drives and servo valve 'closed-loop' control systems. In closed-loop functions, the loading actuator was controlled by feedback from load, strain or position sensors. Set rates or set points and combinations became possible. Baldwin produced some of the first servohydraulic machines in the USA.

As a Company, perhaps the most important development was the strain gauge and strain gauged load cells. Up to this time, load sensors were either scale balance lever types or fluid cells (Emery load weighing capsules).

▲
Baldwin load cell

Because of the success of their testing machines and strain gauge advances, Baldwin assigned these two product lines to BLH, a new company established in 1951. This new company, the Baldwin-Lima-Hamilton Corporation (BLH), was created through the merger of Baldwin and the Lima-Hamilton Corporation, which was originally made up of Lima Locomotive Works and the General Machine Corporation of Hamilton.

BALDWIN BLH LIMA-HAMILTON

While testing machines continued to be a viable product line, load cells and their associated products became the significant business. In fact, a secondary company, Hottinger Baldwin, was established in West Germany to supply the European market.

The BLH group continued their advancements in universal testing during the 1950s and introduced the Mark G servomatic tester in 1957. This new hydraulic motor-driven design featured a single test space for tension and compression testing.

▲
Mark G Series featured a combination servohydraulic/ electromechanical design

Just as World War II was a force in the 1940s, the manufacture and deployment of jet engine aircraft in the 1950s produced the need for environmental testing of materials - most significantly at elevated temperatures. These tests were conducted over long periods of time so less expensive loading systems were required to complete a significant number of tests.

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# History of SATEC™ (continued)

In 1952, Arcweld Manufacturing Company, was established in Pittsburgh, Pennsylvania.

Arcweld began to manufacture a line of creep and stress testers to meet this market demand. The company later moved to Grove City, Pennsylvania in 1955.

▲
Arcweld creep and stress rupture testing machines

In addition to jet engines, companies such as Westinghouse and General Electric were advancing nuclear power. The need for environmental testing was increased to include atmosphere or gaseous conditions and radiation as factors affecting material properties.

## 1960s

The controller developments of the prior decade were refined and advanced in the 1960s. Perhaps more importantly, the concept of closed-loop dynamic testing became an accepted norm. Some solid state electronics were made adaptable to temperature controllers and the end of the vacuum tube based electrical systems was at hand.

The man-on-the-moon program clearly sent waves through the testing industry due to new environmental requirements. Vacuum or high pressure chambers were needed to test at unprecedented high temperatures.

The demands of strength-to-weight materials of the manned space program produced a whole new materials industry. Until the late 50s, the word 'plastic' was best defined as something cheap and breakable. Nonmetallic, petrochemical based materials came to the forefront to solve many material problems of the space age and clearly moved the industry beyond the typical textile applications.

In 1961, BLH licensed the rights to their Baldwin and Sonntag testing machines to the Wiedemann Machine Company of King of Prussia, Pennsylvania.

# History of SATEC™ (continued)

Arcweld Manufacturing Company was renamed SATEC Corporation in 1962 (SATEC then being an acronym for Space Age Testing Equipment Company).

SATEC CORPORATION

In 1964, the Warner & Swasey Company purchased the Wiedemann Machine Company.

THE WARNER & SWASEY CO.

Also in 1964, the Shenango Furnace Company purchased a minority position in SATEC Corporation.

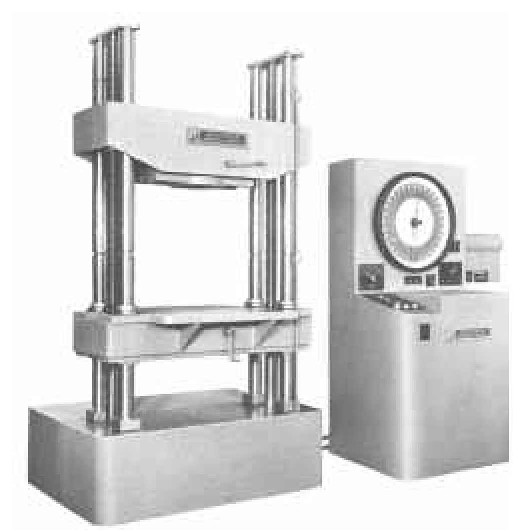
Finally, a joint venture company, SATEC Systems Inc., was established in 1968 by combining the Baldwin/ Sonntag products of Warner & Swasey with the Arcweld products of SATEC. Warner & Swasey and Shenango Furnace Company each held a 50% share.

SATEC Systems, Inc.

The Baldwin line of universal testers continued to improve and expand during the 1960s. The BTE II line evolved from the original BTE machines of the 1930s. This new design featured a welded base and machined crosshead.

▲
BTE II series

The B, BN, WBN, CG and CS series of electromechanical testers were also introduced during this timeframe. These systems ranged in capacity from 10,000 lbf to 200,000 lbf.



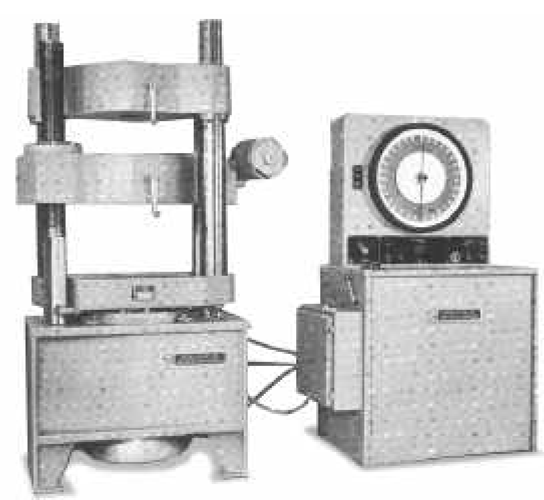
▲
Baldwin's model CS featured a single test space

# History of SATEC™ (continued)

During the 1960s, the SI and BLI impact lines were marketed for Charpy and Izod testing. Bell Telephone Laboratories originally designed the BLI series and licensed the manufacturing rights to SATEC. The SI series was introduced several years later for higher capacity metals testing.

▲
SI (left) and BLI (right) series of impact testers

In 1966, a compact version of the BTE II was designed. This new line became the HV series.



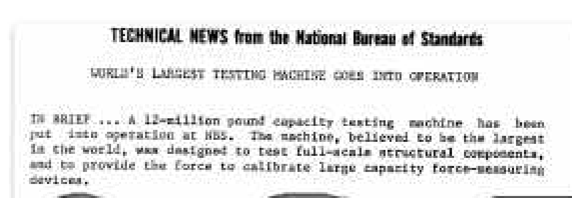
▲
HV series of hydraulic universal testers

## 1970s

'Solid-State' and 'Digital' became the high tech words of the 1970s. The solid-state signal conditioners devised in the 1960s were connected to electromechanical dial indicators. Frequency and pulse counting chips became economically feasible and dials eventually gave way to 'digital' displays. During this period, SATEC introduced its Mark I and Mark II digital indicators.

▲
Control console with Mark II digital indicator

During the 1960s Francis Buckingham of Wiedemann-Baldwin designed what is believed to be the world's largest universal testing machine. With a capacity of 12 million pounds, this machine was intended to test full scale structural components and calibrate load cells. In 1971, this frame was commissioned by the NBS Institute for Basic Standards (now NIST). This hydraulic universal test frame stands 76 feet above the floor and 23 feet below floor level.



TECHNICAL NEWS from the National Bureau of Standards

WORLD'S LARGEST TESTING MACHINE GOES INTO OPERATION

IN BRIEF ... A 12-million pound capacity testing machine has been put into operation at NBS. The machine, believed to be the largest in the world, was designed to test full-scale structural components, and to provide the force to calibrate large capacity force-measuring devices.

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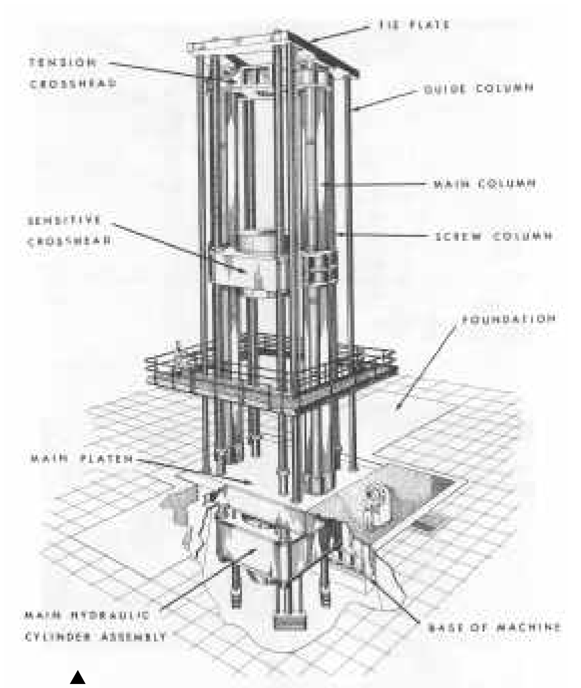
# History of SATEC™ (continued)




▲
12 million lbf UTM at NBS Institute for Basic Standards (now NIST).

In 1973, two new versions of the HV series were offered. The HVP model included a pressure transducer while the HVL model featured a load cell.

▲
HVP model (left) and HVL model (right)

Digital technology not only made digital displays possible but also paved the way for computer applications. Clearly, the biggest advance in testing machine control for SATEC Systems was the development of a computer-based machine control and data collection/ reduction unit. The Microprocessor Assisted Testing System (MATS) was marketed in 1977 and was SATEC System's first software based system for tensile testing applications - believed to be the first such direct digital control system for static testing commercially offered in the USA.

▲
The MATS I controller made possible computer controlled testing

In 1973, Carl Schenck, A.G. of West Germany became a minority shareholder in exchange for a license to SATEC for the manufacture and sale of their dynamic materials testing products.

SATEC - Schenck

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# History of SATEC™ (continued)

## 1980s

With the continued development of computer hardware and expanding markets for computer-based systems, the cost for high performance computers was greatly reduced. Applications of personal computers (PCs) and interfacing with them drove product developments during the 1980s. Higher testing speeds were made possible by using computers to gather and evaluate test data and determine machine control functions 'on the fly'. Complex test sequences, dependent upon test data criteria, were made possible without human intervention during a test.

▲ Operators could set test control speeds and calculation criteria with software programs

This concept was further enhanced in 1985 with the introduction of the Computer Aided Testing System (CATS). This control system was the first direct digital controller placed into the market for closed-loop dynamic testing.

▲ CATS controller for closed-loop fatigue testing

In 1985, SATEC Systems purchased back the outstanding stock owned by Carl Schenck.

In 1987, SATEC Systems Inc. was purchased by a private owner to become SATEC Materials Testing Equipment. SATEC continued to run under private ownership until 1998 and experienced significant growth during this period.

SATEC
Materials Testing Equipment

## 1990s

The 1990s brought advancements in single purpose test frames and software.

▲ Single purpose lines: TVL series (left), RD series (center) and QC series (right)

Originating from the Baldwin CTL series, the new RD series of compression testers was launched in 1990. This design featured

# History of SATEC™ (continued)

an ultra stiff frame for testing high strength concrete. The TVL series was launched in 1990 as well. This new tension-only design was introduced as a cost effective solution for high capacity fastener testing. The low cost QC compression series was developed one year later in 1991.

In 1996, Partner™ Software hit the market as the first Microsoft® Windows® based application for materials testing.


Instron® Corporation purchased SATEC Systems Inc. in August of 1998.

INSTRON®
SATEC™ SYSTEMS

In April 1999, the SATEC division purchased the pipe and pressure testing line of Tech Team Inc.

## 2000 and Today

In 2000, the SATEC division added the 55MT series for low capacity torsion testing to its product line.

▲
Model 55MT1 configured for wire testing

In 2001, the SATEC division adopted the SF line of spring testers formerly manufactured by Wolpert™.

▲
SF series of spring testing line: SF 500 and SF 101 (front), SF 1288 and SF 1230 (back)

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## History of SATEC™ (continued)

In 2003, the SATEC division was renamed the Industrial Products Group. Located in Grove City, Pennsylvania (near Pittsburgh) this division continues to market and manufacture SATEC's traditional static hydraulic testing equipment along with high capacity electromechanical UTMs, torsion testers, impact testers, R.R. Moore Machines, spring testers, pipe and pressure equipment, Sonntag fatigue machines and more!

Also in 2003, the Industrial Products Group introduced the new SATEC Series of single footprint hydraulic UTMs. Available in LX and DX models, these machines feature compact packaging, a modern appearance, high performance electronics and leading edge software.

▲
300LX (left) and 300DX (right)

Today, SATEC remains the brand name for Instron's hydraulically powered universal testing machines.

SATEC™
series

This series traces its origins back nearly seventy years to the Baldwin BTE line of the 1930s. In addition to the SATEC series, Instron continues to manufacture many other products originating from the Baldwin and Arcweld history.

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