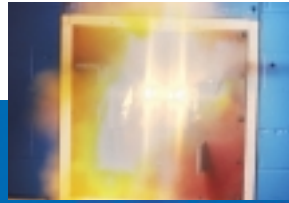
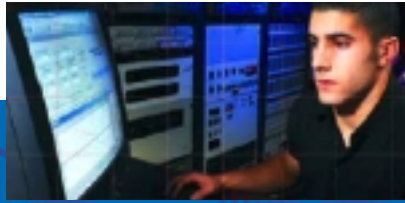


FERRAZ SHAWMUT IS NOW

MERSEN



HIGH POWER TEST LABS

Versatility and responsiveness
for your equipment

OUTSTANDING FACILITIES FOR EVER SAFER ELECTRICAL EQUIPMENT AND INSTALLATIONS



Testing for whom, for what ?

In the field of circuit protection, every one knows the very wide Ferraz Shawmut offering of fuses and fusegear. These products are components dedicated to safety, enabling equipment and installations to fulfil their tasks with no downtime and no harmful effects, thus providing total protection for end users. Customers expect reliability, ease of maintenance, availability and safety. In this very demanding context, design, development, approval and daily inspection are processed through essential electrical, mechanical and environmental tests.

Our focus on efficiency makes the Ferraz Shawmut test facilities extremely productive and affordable for all your testing needs. Our customers turn to us to avoid the inconveniences of long lead-times for test dates, and to gain the advantages of rapid set-up and change-over times allowing us to provide you with more "shots" per day. We appreciate that our customers expect flexibility, and we make every effort to accommodate their unique testing requirements.

Ferraz Shawmut offers our customers global test capabilities for testing products in North America (Newburyport, Massachusetts) and in Europe (Saint Bonnet de Mure, France). Our labs are complementary regarding AC versus DC capabilities, and UL-CSA testing versus IEC testing.

• You are...

- Purchaser
- Technician/designer
- R & D
- Quality, approval, entry inspection manager
- Engineer
- Insurance company
- Official approval or listing agency

• You design and manufacture...

- Semiconductors or equipment incorporating SCs: soft starters, rectifiers, inverters, drives
- Transformers
- Disconnects, circuit breakers, switches
- Electrical boards

• You want to run tests...

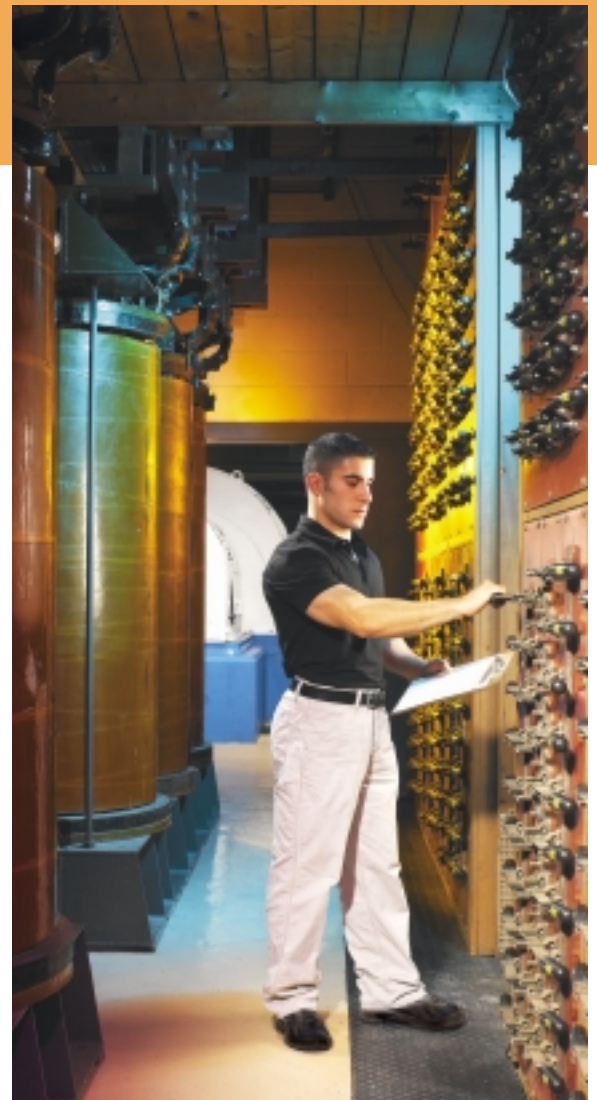
- To qualify products or a design concept, to check selectivity, to validate a critical step in a project
- To inspect production
- For a customer checking procedure
- For approval

WIDE TESTING CAPABILITIES



Comprehensive list of tests done in our labs

- Electrodynamic force withstand of components in electrical systems, busbars or cabinets
- Joule effect withstand (overheating)
- Circuit protection selectivity (between fuse and semiconductor, fuse and circuit breaker, fuse and fused switches)
- Electrical endurance
- Semiconductor characterization (junction, case)
- Overload withstand
 - From hundreds of μs to 10 ms
 - Over 10 ms (AC & DC)
- Thermal cycling via current flows at different ambient temperatures
- Dielectric tests, impulse voltage waves
- Environmental tests
- Acceleration tests up to 6000g and vibrations up to 250N
- X-ray analysis of non-transparent components
- High-speed camera
- Lightning shock waves 4/10 and 8/20 μs – 65kA



In-the-field tests

- Our experts can run tests directly in the field
- Fault and failure analysis in equipment and installations
 - Fault current and voltage measurement

SAINT-BONNET-DE-MURE TESTS LABS FACILITIES

Extra low voltage temperature rise and endurance testing

Fuses and fusegear are temperature rise and aging tested on extra low voltage stations, the current sources. Those sources are installed in an air conditioned room at 23°C.

Voltage, current and temperature values are recorded during the tests.

› ELV temperature rise tests

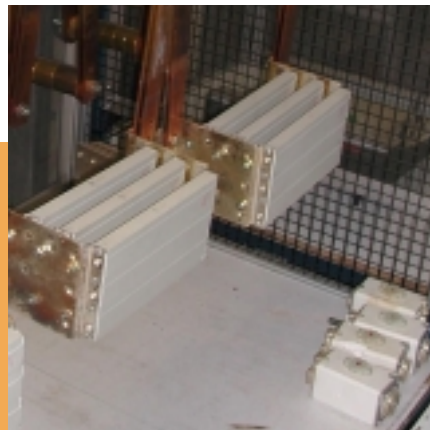
Extra low voltage tests ascertain withstand at rated current and at small overload currents, and measure the corresponding temperature rises and losses.

› Endurance tests

In endurance tests, start/stop cycles simulate actual operation or accelerated aging. The same source stations are used.

› Current generators

- 15 single-phase 50 Hz stations delivering 100 to 9200 amps RMS at voltages from 6 to 24 V AC,
- 18 stations delivering rated current of 1 to 300 amps DC at voltages up to 30 V.



Dielectric strength and impulse testing

› Dielectric tests at industrial frequencies

- 10 and 50 kV RMS manually operated dielectric test stations
- 100 kV RMS automatic dielectric test station

› Impulse voltage tests: Faraday cage

- Waveforms as per standards
- 4/10 or 8/20 μ s, up to 65 kA peak at 100 kV.

Environmental testing

› Climatic tests

- Hot/cold oven tests relative humidity from -45°C to +150°C, capacities up to approx. 200 l
- Salt mist tests

› Mechanical tests

- 100 kN press
- 250 N sinusoidal vibration test equipment
- Variable speed 6000 g acceleration test equipment

› X-ray analysis

- Examination and photography of non-transparent components

Capacitor banks

The lab's technicians enjoy the use of two high capacity capacitor banks to simulate faults with a high current rate of rise:

- 100 mF at 1 200 V

To deliver 100 kA @ 1 μ s with a current rate of rise of 220 A/ μ s

- 30 mF at 2 000 V or 7 mF at 4 000 V

To deliver 100 kA @ 100 μ s with a maximum current rate of rise of 5000 A/ μ s



Short circuit testing

The Ferraz Shawmut test lab has three high power test stations, at 3, 20 and 400 MVA, for 50 Hz short circuit tests. Tests can be run as per standards or designed to order, and anything requiring high power can be considered.

› 3 MVA station

For single-phase or three-phase utility line short-circuit tests up to 8000 amps RMS. Voltage can be adjusted up to 800 V RMS 50 Hz by coupling to the transformer.

Triggering the fault current can be synchronized or set anywhere from 0 to 90° at $\pm 1^\circ$. Voltage can be held for several minutes after the test.

› 20 MVA station

An alternator driven by a 400 CV asynchronous motor generates current. With this equipment single-phase and three-phase tests can be done up to 35,000 amps RMS. Voltage can be adjusted between 80 and 1200 V RMS 50 Hz.

› 400 MVA station

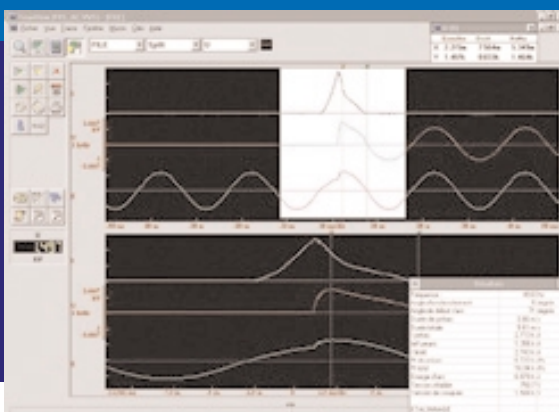
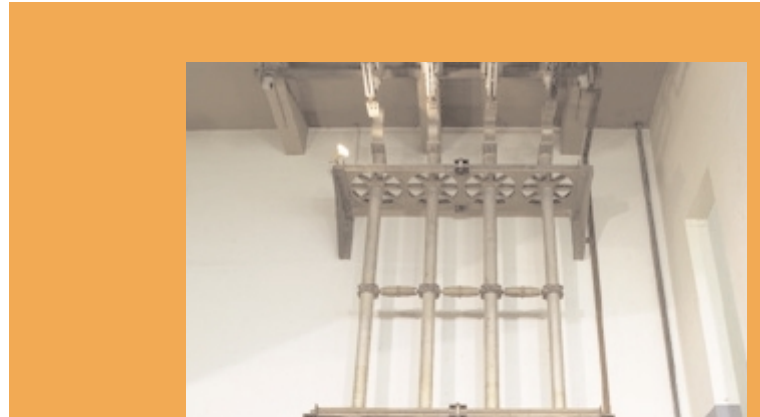
A turbo-generator driven by a 1300 kVA synchronous converter delivers the current. This novel equipment has been running since 1999 and guarantees flexibility and reliability.

Test voltages can be adjusted from 100 V to 45 kV by means of several voltage step-down and step-up transformers and several couplings of the power generator. Maximum RMS short-circuit current can be up to 305 kA RMS, which at 400 V means a peak at 750 kA!

› DC tests

By coupling with one of the three stations, maximum attainable currents can be 15 kA at 1200 V DC, 7.5 kA at 2400 V DC, or 4 kA at 4500 V DC.

A 3 H inductance makes it possible to establish large L/R time constants. Ferraz Shawmut also offers capabilities in direct current testing, with its lab in Newburyport, Massachusetts, USA, where every facility is provided for 100 kA – 1000 V DC tests.



Recording

The three short-circuit test stations are equipped with reliable, precise and fast digital transient recorders, using 12-bit sampling for 1 M samples per second (up to 6 channels for voltage, current, etc.).

The recorders may be separated electrically by fiber optics or by an instrument amplifier.

They are computer-controlled by specific, tried and proven data acquisition and processing software. Their flexibility is such that a vast range of equipment tests is available.

A specific application determines measurement uncertainties.

All the test parameters appear in the test report.

A PARTNERSHIP BASED ON TRUST AND SOLID GUARANTEES



- Ferraz Shawmut's **expertise**: as a specialist in electrical protection, the company develops skills in common with its customers
- Industrial-standard **confidentiality** and security arrangements: ISO 17025 (confidentiality agreements signed by both customers and staff)
- **Attractive prices**: competitive prices for outstanding facilities.
- Perfect **command** of fuses and their environment
- **Thorough grounding** in component failure and end-of-life-cycle
- A **wide range** of tests possible at St-Bonnet-de-Mure.
- **Additional capabilities** with the Ferraz Shawmut test lab in Newburyport, Mass. (for DC and AC 3 - phase tests).
- **Skills**: expert personnel and stringent test procedures. Membership and active participation in the ASEFA, an independent association for Low Voltage product certification that is a member of the European group LOVAG (Low Voltage Agreement Group).
- **Flexibility**: each station has its own specialized technicians
- **Warranty**: COFRAC accreditation 1-0043 as per ISO standard 17025
- **Safety**: hazardous electrical equipment installed in segregated test cells (interlock system). Displays and alarms.
- Trusted by **large OEMs** of all horizons for many years.
- **Expérience**: lab founded in 1981. More than 1,000,000 tests done since then.
- **Responsiveness**: guaranteed lead times, tests done in 2 to 3 weeks depending on complexity.

WHAT WE CAN DO FOR YOU

Some details on technical capabilities

Temperature rise and aging tests

9 000 A/6 V, 20 sources (AC and DC)

Short circuit tests

3 MVA station

Short-circuit RMS current (20 ms)
single-phase

- Max. DC current: 10kA/300V
- Continuous current: 600A/400V

20 MVA station

Short-circuit RMS current (20 ms)
single-phase

- 400 V 22 kA $\cos \phi$ 0.3
- 500 V 28 kA $\cos \phi$ 0.3
- 690 V 11 kA $\cos \phi$ 0.2

Short-circuit RMS current (20 ms)
three-phase

- 400 V 15 kA $\cos \phi$ 0.23
- 500 V 30 kA $\cos \phi$ 0.25
- 690 V 14 kA $\cos \phi$ 0.1

400 MVA station

Generator alone:

- 3 500 V 50 kA $\cos \phi$ 0.06
- 12 000 V 16 kA

With step-down transformer

- 400 V/300 kA $\cos \phi$ 0.07-0.15
- 440 V/185 kA $\cos \phi$
- 550 V/118 kA $\cos \phi$
- 725 V/165 kA $\cos \phi$

With step-up transformer:

- 45 kV/500 A $\cos \phi$ 0.1
- 2 4kV/1 000 A

DC tests

15 kA /1 500 V or 4 kA/4 500 V L/R 3ms

100 kA/1 200 V and 200 kA/4 000V

100 kV and 24kV wave 1.2/50 μ s

salt mist, oven from -50 to +150°C and relative humidity, 250 N vibration test, 6000 g acceleration test, X-ray

How to schedule test time?

Requirements:

- required test conditions
- reference standards
- description of test set-ups
- number of pieces to test
- requested date
- any specific elements that should be highlighted
- names of witnesses

Contact

Sales support

Technical support

In France: 0 820 820 846

Outside France: +33 4 26 29 29 29

ts@fr.ferrazshawmut.com

NEWBURYPORT TESTS LABS FACILITIES

High-Power Facility

› Test control

All testing is controlled and can be observed in the safety of a separate, isolated control room. The test cells and operators are segregated for safety, and operators control all test functions via state-of-the-art digital or fiber optic links to the test station cells. Short circuit test data is conveniently collected via the control room in a variety of ways:

Acquired by six Digital Storage Scopes through:

- Coaxial shielded double-cable

- Fiber Optic isolation transmitters and receivers

High fault currents and voltages are linearly stepped-down, or transduced to low level signals that can be measured by the scopes by using:

- Resistive shunts

- Current transformers

- Isolation transformers

All signal analysis equipment is calibrated with a tolerance of $\pm 1\%$.

› Test Cells / Device Connection

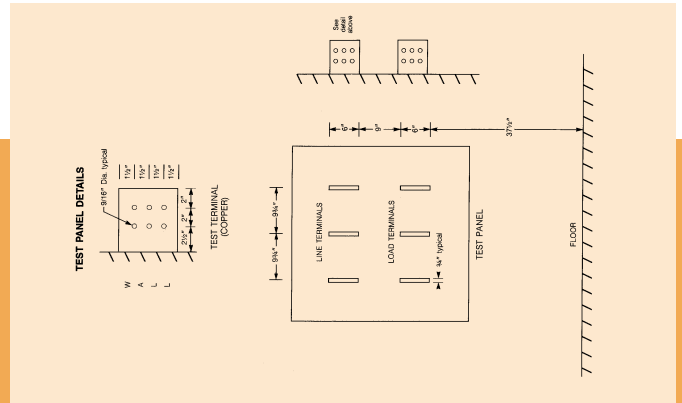
The test area is comprised of a 3-cell configuration.

Cell 1: Primarily used for single-phase testing – fuses, single-pole breaker, mov's, cable connectors, etc.

Cell 2: All 3-phase testing is completed in this location – 3-phase switch-gear, motor controllers, transformers, circuit-breaker etc.

Cell 3: This is our medium-voltage cell (max. – 38,000 volts)

All devices under test are connected directly to the associated cell's copper bus-bar.



Data Acquisition & Analysis

› Nicolet 430 Digital Storage Oscilloscopes

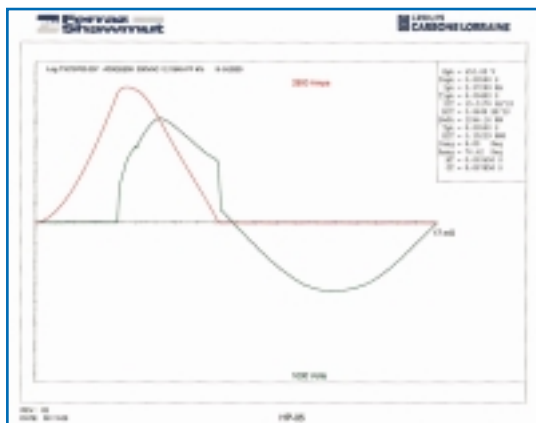
- 32,000 bits-per-sweep
- 12 bit/10Mhz Digitizer
- Master/Slave Capabilities
- Variable Input Filters
- Single/Live Modes
- Stores to 3 1/2" Disk
- Sampling from 100e-9 and Up
- Six Individual Scopes Available

› Ferraz Shawmut Waveform Analysis Software

Digital oscilloscopes are connected via an IEEE.488 bus, and interface with the PC for analysis Test Lab engineers use the PC to control all scope functions Waveform analysis software program reads the digitized information from scopes, into the PC, and outputs graphical and text information about the short circuit event.

› Data Output presentation options are:

- Display on PC screen
- Output displayed and graphed to Plotter
- Output displayed and graphed to Deskjet
- Output displayed and saved to PC File



› Graphical Description of Interruption

- E_{pk} = Voltage Peak
- T_{epk} = Time to Voltage Peak
- I_{pk} = Current Peak
- T_{ipk} = Time to Current Peak
- IIT = Energy Value of Current Envelope
- MIT = Energy Value prior to melt
- P_{wPk} = Peak Power
- T_{pk} = Time of Peak Power
- EIT = Voltage-Current-Time ratio
- A_{ang} = Arc Angle
- C_{ang} = Closing Angle
- MT = Melt Time
- CT = Clearing Time

Red Trace = Current/Green Trace = Voltage

NEWBURYPORT TESTS LABS FACILITIES



High-Power Facility

› Power

Our test station uses two 3600 RPM synchronous alternators used in parallel to produce the high currents for short-circuit testing. Each alternator is driven by a 4160 volt, 536 hp electric motor.

› Load

Currents from the generators are fed to Ferraz-Shawmut's custom-made load banks consisting of high power resistors and concrete reinforced inductors. The load banks are quickly adjustable to allow short circuit current regulation from 1 – 100,000 amperes with a full range of power factors for AC circuits and time constants for DC circuits .

› Output

A wide variety of test voltages can be produced, allowing a corresponding range of short circuit test-currents. To acquire desired test voltages, test lab engineers monitor and adjust generator excitation current via remote control.

› DC Rectifier

Direct Current test circuits are energized by a highspeed, bounce-free synchronized closing switches. DC capabilities include currents + 100,000 amps and below, at a variety of voltage ratings.



Low Power Test Lab Capabilities

› Clearing Test

0 – 6000 Amps continuous

› Cycling Test

- Simulates starting and stopping of a system
- 0 – 3000 Amps for a given cycling rate – not a continuous rating

› Temperature Test

Custom system used to monitor and store temperature data over a required time – system utilizes Labtec software to analyze and chart the rates of change.

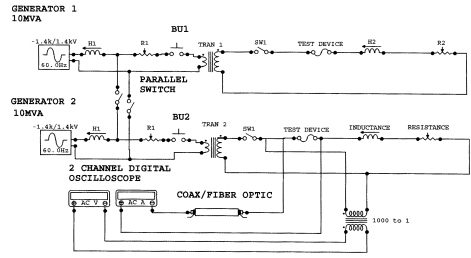
- Thermal couples transmit data to analyzing software
- Voltage drop is continuously monitored by the Labtec system to produce time/voltage charts

› Verification

At test completion, all temperature values and time of clearing will be verified using U.L., MSHA, CSA, and EIC standards. The Low-Power Lab utilizes variable transformers to produce currents which restrict voltage levels to less than 10VAC



Low Power Test Lab Capabilities



Single phase/Three phase

125 VAC

0 – 45,000 Amps 12% Power Factor

250 VAC

0 – 100,000 Amps 12% Power Factor

277 VAC

0 – 100,000 Amps 9% Power Factor

480 VAC

0 – 100,000 Amps 9% Power Factor

500 VAC

0 – 100,000 Amps 9% Power Factor

600 VAC

0 – 100,000 Amps 7% Power Factor

700 VAC

0 – 50,000 Amps 5% Power Factor

1000 VAC

0 – 75,000 Amps 5% Power Factor

All Power Factors are available

Direct current

130 VDC

0 – 50,000 Amps 13ms Time Constant

300 VDC

0 – 100,000 Amps 10ms Time Constant

600 VDC

0 – 100,000 Amps 10 ms Time Constant

700 VDC

0 – 100,000 Amps 10 ms Time Constant

1000 VDC

0 – 85,000 Amps 8ms Time Constant

1250 VDC

0 – 140,000 Amps 3ms Time Constant

Circuit Values AC/DC

Primary

Inductance: max .0029h - min .0000242h

Resistance: max.38 ohms - min .000002 ohm

Secondary

Inductance: max .079h - min .00018h

Resistance: max 78 ohms - min .035 ohms

Bypass Pri/Sec

Values approach zero

Specific Circuit Values Can Be Fabricated To Meet Customer Needs

Generators: 10 MVA continuous-rated alternator (shortcircuit rated 68 MVA) generating 2400 volts @ 60hz

BUI: HK type circuit-breaker to interrupt test voltage after preset

HI: Continuous-duty primary inductors from 0 to 1.12 ohms

RI: Continuous-duty primary resistor from 0 to .6 ohms

Transformers: 10MVA continuous-rated (68 MVA shortcircuit) transformer with tap and voltage selection

SWI: Specially designed 100KA Making Switch – the closing angle may be controlled +/- 1 degree of a possible 180 degrees

H2: Continuous-duty secondary inductors from 0 to 1k ohms per phase

R2: Continuous-duty secondary resistor from 0 to 1k ohms

Data Acquisition: G.E. current-transformers and resistive shunts transmit interruption to digital oscilloscopes via coaxial cable or fiber optics

When a test date has been arranged, the client will be sent an Engineering Test Agreement which must be filled out and returned prior to the test date. This agreement verifies the test date, and sets forth contract conditions for the client and the lab. Liability and responsibility are explained in the test agreement.

Requirements

- Client Purchase Order
- All witnesses to test must conform to Test Lab Visitor's Safety Policy
- Clients must read and sign Visitor's Safety Policy
- Test Lab recommends that the client have an engineer present during actual testing to ensure compliance to any special requirements

Testing

- Summary sheet of test lab charges is available on request and will be sent with the Engineering Test Agreement
- Testing is normally run in accordance with recognized standards such as UL, CSA, MSHA, and EIC
- All testing is treated with the strictest confidential awareness

To schedule test time, contact the Test Lab Manager via e mail, telephone, or in writing, at:

North America

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