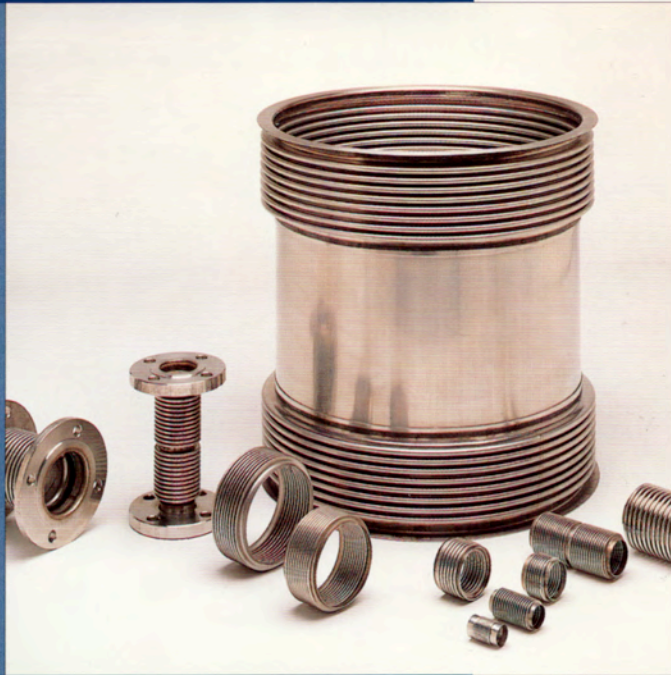


METALLIC BELLOWS

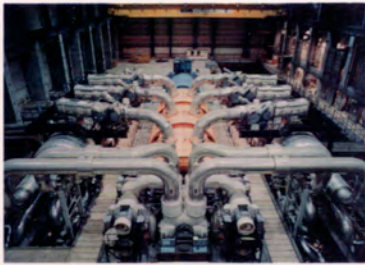


**EXPANSION JOINTS
FOR PRESSURIZED PIPEWORK**

Teddington Bellows, a part of the Wahlco Engineered Products (WEP) Division, pioneered the development and manufacture of cold-rolled, thin-walled, true multi-ply stainless steel bellows.

Today, Teddington™ brand bellows are used in expansion joints to accommodate the movement of pressurized piping systems caused by thermal growth, pressure contraction, subsidence, machine vibration, seismic disturbances, and installation irregularities. The bellows carry numerous types of media, including steam, emission gases, water, acids, alkalies, hydrocarbons and molten sodium.

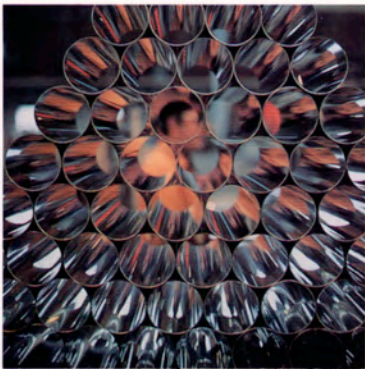
Applications include fossil fuel power generation, gas turbines, nuclear reactors (primary and secondary systems), petroleum refining, chemical processing, hot metal industries, shipbuilding, district heating and steam distribution systems, HVAC equipment, engine exhaust systems, aviation and aerospace ductwork, pulp and paper processing, heat exchangers, and other industrial piping systems.



Hot and cold reheat pipework and expansion joints for Daya Bay PWR Nuclear Power Station, Guangdong Province, China. There are two generators, each 985 MW.



A typical selection of small diameter axial bellows used on HVAC equipment and district-heating applications.



Stainless steel tubes prior to bellows forming.

ENGINEERED ACCOMMODATION OF PIPEWORK MOVEMENT

BELLOWS FOR ANY ENVIRONMENT

Teddington bellows are designed to operate under very severe temperatures and pressures—from absolute zero to 1,500°F and full vacuum to 3,000 psig, depending upon the bellows' diameter. Bellow thicknesses range from 0.005" to 0.250" for single-ply, and multi-ply thicknesses of up to four ply, from 0.005" to a total multi-ply thickness of 0.250", depending upon the diameter of the bellows.

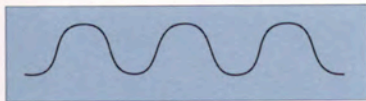
INFINITE INCREMENTAL SIZES

Bellows can be made from 0.5" to 20' and larger in diameter, with *standard* bellows ranging from 1" to 72" in diameter. WEP's unique convolution-forming processes can produce bellows at non-standard (incremental) diameters.

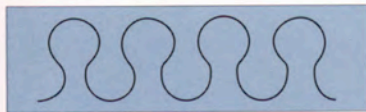
DURABLE, CORROSION-RESISTANT MATERIALS FOR ELEVATED TEMPERATURES

WEP's expansion joint engineers select the appropriate bellows materials for each individual application, based on required strength, operating temperature, and corrosion resistance. Standard bellows material is 321 stainless steel; other available alloys include:

- Selected 300 Series Stainless Steels
- Incoloy® 800, 800H and 825
- Alloy 718 and X750
- Monel® 400
- Inconel® 600 and 625
- Nimonic® 75 and 80A
- Hastelloy® B and C Series
- Titanium
- Aluminum



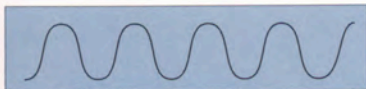
Semi-Toroidal



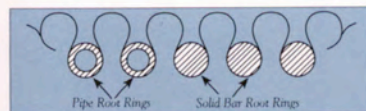
S-Shaped



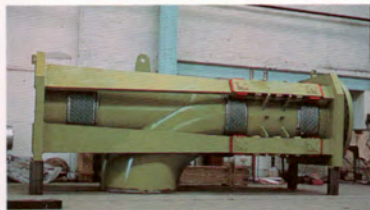
Parallel-Side



Open Convolution



Root Rings

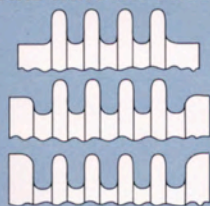


48" diameter pressure-balanced joint for cold reheat pipe of a nuclear power plant.



36" diameter double articulated unit for cold reheat pipe at a power plant.

TYPICAL TANGENT PROFILES



A Special Teddington Bellows Feature:
Bellows are available with tangents terminating at virtually any diameter between the bellows' inside and outside diameters (I.D. and O.D.).
This flexibility gives the customer greater

freedom when designing the end-components.
The bellows attachment weld can therefore be moved from the conventional I.D. bellows position to the O.D. position without sacrificing bellows performance.

CONVOLUTIONS AVAILABLE

Convolutions are available in a wide range of profiles. On the left are illustrations of some of the profiles used in various Teddington bellows.

STYLES OF EXPANSION JOINTS

WEP engineers will determine the most appropriate and economical expansion joint style and design for a given application.

- **End Attachments:** Bellows assemblies can have butt weld ends or flanged ends, as well as customized end fittings to meet specific customer needs.
- **Number of Bellows Sets:** Single, double and multiple bellows sets are available.
- **Bellows Shapes:** Round, rectangular, and other special shapes.
- **Styles of Expansion Joints:** WEP offers many expansion joint styles, including:

Axial—Single or double bellows sets, with or without anchor bases.

Universal—Single or double tied units, with two or more tie rods.

Articulated—Single or double hinged and single or double Gimbals.

Pressure-Balanced—Three different configurations: In-Line, Elbow or Tee.

Applied-Pressure—Internal or external to bellows.

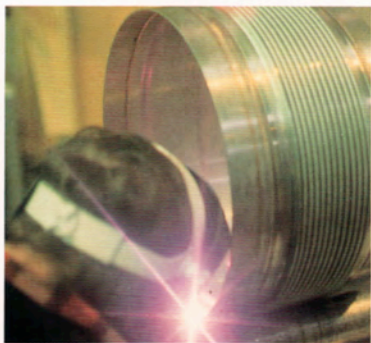
Pantographic linkages for articulated or universally-tied expansion joints are also available, as are limit rods, liners, covers and reinforcing rings (including root rings and self-equalizing rings). When required, leak detection devices are available for sensing leaks either between the various plies or between concentric bellows.



Finite element analysis performed on load-bearing structures for a restrained expansion joint.



A technician using a projection microscope to verify the acceptance standards of a bellows component.



Precision TIG welding of bellows to carbon steel pipe ends.

COMPLETE METALLURGICAL CAPABILITIES

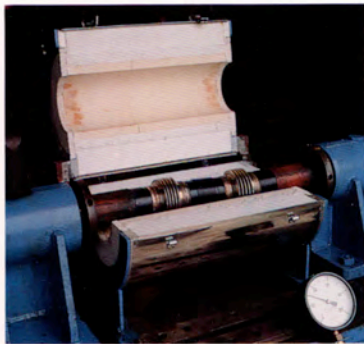
WEP's comprehensive Metallurgical Laboratory works closely with the Research & Development and Bellows Performance Analysis Departments.

INTEGRATED MANUFACTURING FOR SPEEDY TURNAROUND

All materials can be welded, expanded, formed, tested and painted under one roof, enabling WEP to meet the most stringent delivery schedules while maintaining the industry's highest quality.

WEP has refined its auto-TIG welding process to create longitudinal butt welds that are of high integrity as verified by non-destructive testing (NDT). The resulting welds match the parent metal strength, with the smallest possible heat-affected zone.

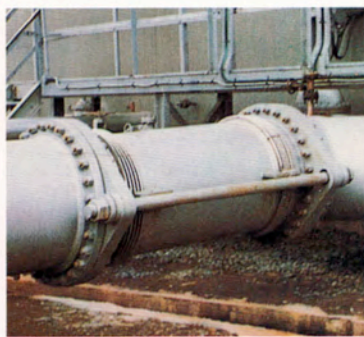
WEP designs much of its own tooling, giving unrivaled metal-forming capabilities. Bellows convolutions are formed on one of 18 specially-built forming machines, offering an exceptionally wide range of convolution profiles.



Test rig for high-temperature testing of an expansion joint to be installed in an automobile's exhaust system.



Radiographic examination of circumferential butt welds in a typical pipework system.



Double tied bellows for petroleum tank settlement. The bellows accommodate tank settlement and other vertical or lateral movements, minimizing stress on both the tank walls and adjoining pipework.

EXACTING COMPLIANCE TO NATIONAL & INTERNATIONAL STANDARDS

All products are manufactured and tested to meet the rigorous guidelines set forth by the Expansion Joint Manufacturers Association (EJMA). Comprehensive in-house testing and inspection programs include:

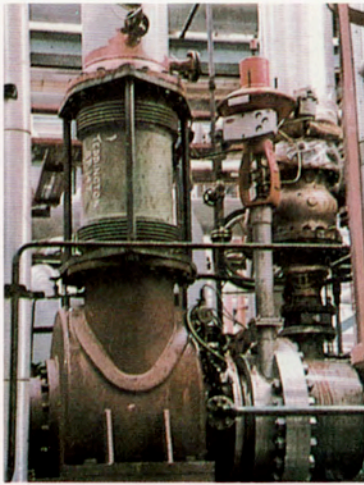
- Materials testing, identification and documentation.
- Non-destructive testing by radiographic and liquid penetrant examination.
- Leak detection by hydrostatic and pneumatic pressure testing.
- Base material and weld deposit analysis by hardness testing.
- Bellows spring characteristics verification by spring rate testing (load/deflection testing).
- Life expectancy verification by extensive mechanical deflection testing.

WEP's Quality Systems are independently assessed and fully approved for both the design and manufacture of bellows to the following requirements:

- ISO 9001
- BS 5750 Part 1
- EN 2.9001



Tuyere stock expansion joints for a blast furnace. Iron and steel industry applications also include hot and cold blast mains, gas mains and fume extraction systems.



A petrochemical plant using a multi-tied expansion joint to absorb pipework deflections and minimize stresses.



Gimbal bellows are used in the hot air ductwork of this jet's Rolls Royce engines. Other aviation and aerospace applications include the accommodation of thermal growth in hydraulic and fuel systems.

Quality systems for Teddington brand bellows comply with national and international standards of design and manufacture. Some of these standards are listed below, together with some of the independent inspection authorities:

- American Society of Mechanical Engineers—ASME Section III (Nuclear) relevant sections
- ASME Section VIII & IX
- ANSI B31.1 and B31.3
- MIL-E-17813, MIL-I-45208A
- USCG CF115
- AB Sveriges Tekniska (STK)
- Stoomwezen
- BS 5750 Part 1
- ISO 9001
- EN 2.9001
- Civil Aviation Authority (CAA)
- Technischer Überwachungs-Vereine.V
- Defence Quality Assurance Board (DQAB)
- Lloyd's Register of Shipping
- Bureau Veritas
- Det Norske Veritas
- National Vulcan Insurance Co. Ltd.
- The British Engine and Boiler Insurance Co. Ltd.
- United Kingdom Atomic Energy Authority
- AD Merkblatt B.13
- API Cryogenic

WAHLCO 
ENGINEERED PRODUCTS

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North American Sales Office: 4707 College Blvd., Suite 205, Leawood, KS 66211 USA • Phone (913) 345-9770 • FAX: (913) 345-9678

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