

SUBSTATION TRANSFORMERS

Three-Phase, Liquid-Filled



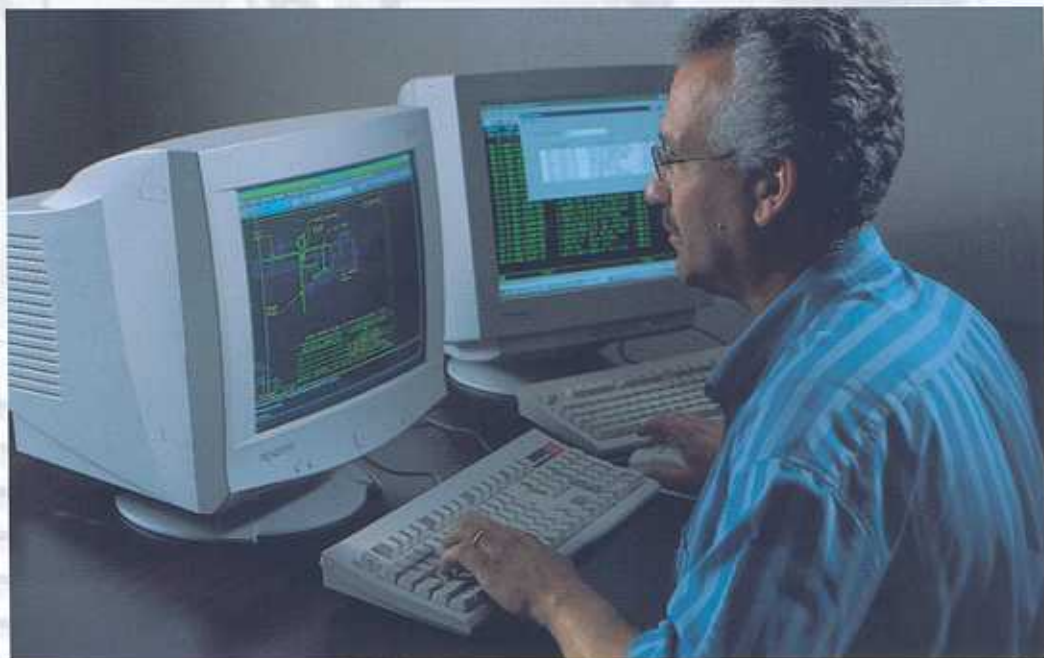
**HOWARD
INDUSTRIES, INC.**

ISO-9001 CERTIFIED
Bulletin 1004-01



Howard Industries Excels at Delivering Exactly What Our Customers Want.

The Product Automated Design System (PADS) insures that each customer's unique requirements are satisfied.



Life-Cycle Cost Reduction

Howard Industries' Customer Assistance Team excels at helping customers find ways to reduce cost. Using activity-based cost analysis techniques, our commercial and technical experts help customers analyze costs throughout the transformer supply chain, identifying and eliminating activities which add cost but have little or no value.

Quality and Reliability Built into Every Transformer

Higher quality means lower failure rates ... and that translates into lower operating and maintenance costs. Higher quality also means customers can reduce cost by reducing or eliminating incoming receipt inspection and testing.

At Howard Industries our Quality Assurance Program is designed to achieve the high level of quality required by our most demanding customers. Abandoning the traditional manufacturing-only focus, we have created a quality system that links all aspects of the company's operations including Marketing, Engineering, Management Information Systems, Manufacturing, Shipping and Accounting to make sure that not only our products, but everything we do for our customers is of the highest quality.

Howard Industries' quality management system has earned ISO-9001 certification. ISO-9001, the most comprehensive standard in the internationally recognized ISO-9000 series, covers design, manufacturing and servicing systems. This achievement demonstrates Howard Industries' commitment to continuous quality improvement.



Automated and robotic welders perform 100% of all oil-compartment seam welds.



Electrostatically applied powder paint provides a durable, corrosion-resistant finish.



Computerized final test stations perform a complete series of electrical tests prior to shipment.

Designs Optimized for Superior Performance and Economy

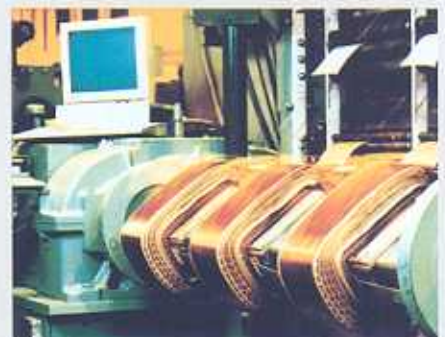
Our design philosophy is to provide our customers exactly what they want. That means transformers that are individually designed in precise accordance with each customer's specifications. Each transformer design is optimized to satisfy the customer's needs at the lowest possible cost.

Howard's Product Automated Design System (PADS) is driven directly by each customer's specifications to insure that all the necessary

requirements are satisfied. PADS synthesizes each transformer design and produces all critical manufacturing documents. PADS then links with a sophisticated computer-integrated-manufacturing (CIM) system to automatically carry-out fabrication on the factory floor. The PADS and CIM systems eliminate manual processes and their inherent inefficiency and error, and make it possible to quickly modify and customize transformer designs.

Advanced Manufacturing

Howard transformers are manufactured in the largest, most advanced facility of its kind. The 1.6 million square foot Laurel plant is the result of a recent three-year, \$50 million expansion project, which saw the introduction of the latest and most sophisticated robotics and automated process equipment available.





Substation Transformer Features

Howard Industries liquid-filled substation transformers are designed for a wide range of commercial, industrial, and utility applications. They are an ideal choice for manufacturing facilities, chemical plants, refineries, office buildings, schools, hospitals, restaurants, banks, Internet service facilities, and shopping centers. As a result of our exceptionally high standards for design and manufacturing, our customers can be assured of substation transformer products that meet the most exacting requirements for safety, reliability, functionality, and economy.

Four basic substation configurations are available. **Primary open substations** have cover mounted high-voltage and low-voltage bushings and have low-voltage ratings above 1.0 kV. **Secondary open substations** have cover mounted high-voltage and low-voltage bushings and have low-voltage ratings of 1.0 kV or less. **Primary unit substations** have sidewall mounted high-voltage or low-voltage bushings (or both), have low-voltage ratings above 1.0 kV, and can be supplied with mounting provisions for mechanical and electrical interconnection with high-voltage and low-voltage switchgear. **Secondary unit substations** have sidewall mounted high-voltage or low-voltage bushings (or both), have low-voltage ratings of 1.0 kV or less, and can be supplied with mounting provisions for mechanical and electrical interconnection with high-voltage and low-voltage switchgear.

All of these substation configurations can be designed for indoor or outdoor use. Our experienced design team can provide customized designs for new applications or for jobs requiring replacement of existing transformer equipment. A wide range of features and accessories are available to satisfy almost any requirement.

Standard Features and Accessories

- Meets or exceeds latest applicable ANSI and NEMA standards
- 60 Hertz operation
- 65° C average temperature rise (self-cooled, OA rating)
- Thermally upgraded insulation system
- Core/coil optimized for lowest owning cost or lowest purchase price
- Four 2-1/2 percent full-capacity high-voltage taps (two above and two below rated voltage with externally operated switch for de-energized operation (may not be available on units with series multiple high-voltage ratings)
- Side-wall or cover-mounted high-voltage bushings (must be cover mounted for ratings above 34.4 kV.)
- Side-wall or cover-mounted low-voltage bushings
- Welded mild steel tank construction
- Corrosion-resistant hardware
- Permanently attached cooling panels (when panels are necessary for proper cooling)
- Bolted hand-hole access to internal tank compartment
- Lifting hooks for balanced lifting
- Bottom drain valve with filter press connection
- Provision for top filter press connection
- Tank grounding pad
- Base suitable for jacking or rolling
- Full-height flange for side-mounted high-voltage bushings (high-voltage ratings of 34.4 kV and below only)
- Full-height flange for side-mounted low-voltage bushings
- Flexible conduit for control wiring
- Aluminum diagrammatic nameplate, laser engraved
- Electrostatically applied powder paint finish with polyurethane topcoat, ANSI 61 light gray
- Mineral oil dielectric coolant



Standard KVA and Voltage Ratings



(Far left) Illustration of secondary open substation with cover mounted high-voltage bushings and front mounted low-voltage bushings.



(left) Illustration of secondary unit substation with sidewall mounted high-voltage and low-voltage bushings, and mounting provisions for interconnection with high-voltage and low-voltage switchgear

Primary Open Substation

KVA Ratings (65°C Rise, Self-Cooled, OA)
225, 300, 500, 750, 1000, 1500, 2000, 2500,
3000, 3500, 5000, 7500, 10000

High-Voltage Ratings (Delta or Y)
2400 through 69000 (through 350 kV BIL)
(Some high-voltage and kVA combinations are not available. Contact factory for details.)

Low-Voltage Ratings (Delta or Y)
120 through 8400 or 14400Y (through
110 kV BIL)

(Some low-voltage ratings are not available for all kVA sizes. Some low-voltage and high-voltage rating combinations are not available. Contact the factory for details.)

Secondary Open Substation

KVA Ratings (65°C Rise, Self-Cooled, OA)
112.5, 150, 225, 300, 500, 750, 1000, 1500,
2000, 2500, 3000

High-Voltage Ratings (Delta or Wye)
2400 through 69000 (through 350 kV BIL)
(Some high-voltage and kVA combinations are not available. Contact factory for details.)

Low-Voltage Ratings (Delta or Wye)
120 through 480 (30 kV BIL)
(Low-voltage ratings of 208Y/120 and 240 Delta are available through 1000 kVA only.)

Primary Unit Substation

KVA Ratings (65°C Rise, Self-Cooled, OA)
225, 300, 500, 750, 1000, 1500, 2000, 2500,
3000, 3500, 5000, 7500, 10000

High-Voltage Ratings (Delta or Y)
2400 through 69000 (through 350 kV BIL)
(Some high-voltage and kVA combinations are not available. Units with high-voltage ratings of 34400 and higher must have cover-mounted high-voltage bushings. Contact the factory for details.)

Low-Voltage Ratings (Delta or Y)
120 through 8400 or 14400Y (through
110 kV BIL)

(Some low-voltage ratings are not available for all kVA sizes. Some low-voltage and high-voltage rating combinations are not available. Contact the factory for details.)

Secondary Unit Substation

KVA Ratings (65°C Rise, Self-Cooled, OA)
112.5, 150, 225, 300, 500, 750, 1000, 1500,
2000, 2500, 3000

High-Voltage Ratings (Delta or Wye)
2400 through 69000 (through 350 kV BIL)
(Some high-voltage and kVA combinations are not available. Units with high-voltage ratings of 34400 and higher must have cover-mounted high-voltage bushings. Contact the factory for details.)

Low-Voltage Ratings (Delta or Wye)
120 through 480 (30 kV BIL)
(Low-voltage ratings of 208Y/120 and 240 Delta are available through 1000 kVA only.)

(Note: Contact your distributor or factory representative for availability of other kVA sizes, voltage ratings, features, accessories and design standards not listed.)



Optional Features and Accessories

- 50 Hertz operation
- 55°/65° C average temperature rise
- Delta/wye high-voltage windings with externally operated switch for de-energized operation (150 kV BIL and below only)
- Series multiple high-voltage windings with externally operated switch for de-energized operation (150 kV BIL and below only)
- Non-standard high-voltage taps with externally operated high-voltage switch for de-energized operation (may not be available on units with series multiple high-voltage ratings)
- Keyed lock for externally operated switches
- Electrostatic shields
- Full height air terminal chamber
- Secondary bus duct throat (instead of full-height flange)
- Air terminal box
- Outdoor throat adapter (for connection to switchgear in outdoor applications)
- Cover mounted buss duct throat
- External fuses
- High-voltage surge arresters
- Low-voltage surge arresters
- Internally-mounted bushing current transformer
- Neutral grounding resistor
- Provisions for future forced-air cooling system
- Forced-air cooling system
- Control power transformer
- Rigid conduit for control wiring
- Stainless steel tank construction
- Removable cooling panels
- Skid mounting
- Top filter press valve
- Tank ground connector
- Pressure/vacuum gauge (with or without alarm contacts)
- Liquid temperature gauge (with or without alarm contacts)
- Liquid level gauge (with or without alarm contacts)
- Cover-mounted pressure relief device (with or without alarm contacts)
- Rapid pressure rise relay
- Dial-type hot spot indicator
- Shock indicator for shipment
- Custom stenciling and labeling
- Stainless steel diagrammatic nameplate, laser engraved
- Special topcoat color (ANSI 70, ANSI 49, or ANSI 24)
- R-Temp[®], silicone, or seed-based vegetable dielectric coolant



(Note: Contact your distributor or factory representative for availability of other kVA sizes, voltage ratings, features, accessories and design standards not listed.)

Howard Industries Distribution Transformers are Available in a Complete Range of Types, Sizes and Voltage Ratings.



Single-Phase Pole-Mounted

Available in capacities ranging from 1.0 through 833 kVA. Voltage ratings through 19.9/34.5 kV, 200 kV BIL. Refer to *Bulletin 1001*



Three-Phase Pole-Mounted

Available in capacities ranging from 30 through 150 kVA. Voltage ratings through 34.5/19.9 kV, 150 kV BIL. Refer to *Bulletin 1001*



Single-Phase Pad-Mounted

Available in capacities ranging from 10 through 250 kVA. Voltage ratings through 19.9/34.5 kV, 150 kV BIL. Refer to *Bulletin 1002*



Single-Phase Subsurface

Available in capacities ranging from 10 through 250 kVA. Voltage ratings through 19.9/34.5 kV, 150 kV BIL. Refer to *Bulletin 1003*



Three-Phase Substation

Available in capacities ranging from 112.5 through 10,000 kVA. Voltage ratings through 69 kV, 350 kV BIL. Refer to *Bulletin 1004*



Three-Phase Pad-Mounted

Available in capacities ranging from 30 through 7,500 kVA. Voltage ratings through 34.5/19.9 kV, 250 kV BIL. Refer to *Bulletin 1005*

Facilities

Howard Industries operates three manufacturing facilities in Laurel and Mendenhall, Mississippi, and two service locations in Ellisville, Mississippi, and Weirton, West Virginia. Every Howard facility utilizes the latest available technologies to provide its customers with world-class products and services.



Laurel Transformer Facility

Located in Laurel, Mississippi, the 1.6 million square foot facility is responsible for production of the company's electrical distribution transformer product lines and is also corporate headquarters for Howard Industries, Inc.



Laurel Ballast Facility

The Laurel, Mississippi facility is headquarters for the Lighting Ballast Division and produces the company's line of electronic fluorescent lighting ballasts. The facility is also home for Howard Computers.



Mendenhall Ballast Facility

The Lighting Ballast Division's lines of magnetic fluorescent ballasts and high-intensity-discharge ballasts are produced at its facility located in Mendenhall, Mississippi.



Ellisville Transportation Facility

The Ellisville, Mississippi facility is the location for Howard Transportation, Inc., including its corporate headquarters, truck maintenance shop and computerized dispatch center. A regional terminal is located in Weirton, West Virginia (not pictured).

Howard Industries' Business Units



www.howardtransformers.com

Transformer Division

Howard Industries' Transformer Division is this country's leading manufacturer of oil-filled electrical distribution transformers. The Laurel manufacturing facility produces a complete line of overhead, pad-mounted, subsurface and unit substation transformers that are widely used by electric utilities, and by industrial and commercial operations.



www.howard-ballast.com

Lighting Ballast Division

Howard Industries' Lighting Ballast Division is a world-class supplier of magnetic and energy-efficient electronic fluorescent ballasts, and of high-intensity-discharge (HID) ballasts for the lighting industry.



www.howardcomputers.com

Computer Division

Howard Industries' newest business unit, Howard Computers, manufactures a complete selection of built-to-order personal computers, including servers, desktops, towers and notebooks.



www.howard-ind.com

Transportation Division

Howard Transportation, Inc., a wholly-owned subsidiary of Howard Industries, Inc., operates as a full-load, flat-bed common carrier truck line and brokerage operation, transporting commodities and industrial goods throughout the continental United States.



Visit our web site at <http://www.howard-ind.com>

HOWARD INDUSTRIES, INC.

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