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Natural gas screw expander unit

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Foreword

This document is drafted in accordance with the provisions of GB/T 1.1-2020 Standardization Work Guidelines—Part 1: Structure and Drafting Rules for Standardization Documents.

Please note that certain contents of this document may involve patents. The issuing authority of this document shall not be liable for identifying such patents.

This document is proposed by the China Electrical Equipment Industry Association.

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Natural gas screw expander unit

1 Scope

This document establishes the classification by structural types, technical requirements, explosion-proof requirements, safety requirements, test methods, inspection rules, marking, factory documentation, packaging, transportation and storage of natural gas screw expander (units).

This document applies to natural gas screw expander (units) with a design pressure not exceeding 10 MPa that utilize the pressure energy of natural gas pipeline networks to output power for driving generators or powering mechanical equipment such as fans and water pumps.

This document also applies to screw expander (units) used in explosive hazardous areas where flammable gas and vapor mixtures of Group IIA, IIB, IIC and Temperature Class T1 to T4 are present or may be present.

Other types of screw expander (units) that generate power using flammable and explosive gases shall refer to the provisions of this document.

2 Normative References

The following documents contain provisions which, through normative reference in this document, constitute indispensable provisions of this document. For dated reference documents, only the edition corresponding to the date applies to this document; for undated reference documents, the latest edition (including all amendments) applies to this document.

GB/T 150 (all parts) Pressure Vessels

GB/T 151 Heat Exchangers

GB/T 755 Rotating Electrical Machines—Rating and Performance

GB/T 3797 Electrical Control Devices

GB/T 3836.1 Explosive Atmospheres—Part 1: Equipment—General Requirements

GB/T 3836.2 Explosive Atmospheres—Part 2: Equipment Protected by Flameproof Enclosures "d"

GB/T 3836.3 Explosive Atmospheres—Part 3: Equipment Protected by Increased Safety "e"

GB/T 3836.28 Explosive Atmospheres—Part 28: Non-electrical Equipment for Explosive Atmospheres—Basic Methods and Requirements

GB/T 4208 Degrees of Protection Provided by Enclosures (IP Code)

GB/T 4942 Degrees of Protection Provided by the Integral Design of Rotating Electrical Machines (IP Code)—Classification

GB/T 13306 Nameplates

GB/T 14285 Technical Code for Relay Protection and Security Automatic Devices

GB/T 14711 General Safety Requirements for Small and Medium-sized Rotating Electrical Machines

GB/T 14976 Seamless Stainless Steel Pipes for Fluid Transportation

GB/T 18430.1 Vapour Compression Cycle Water Chilling (Heat Pump) Packages—Part 1: Water Chilling (Heat Pump) Packages for Industrial or Commercial and Similar Applications

GB 19517 National Safety Technical Code for Electrical Equipment

GB/T 20136 General Test Methods for Internal Combustion Engine Power Stations

GB/T 20320 Wind Energy Generation Systems—Methods for Measuring and Assessing the Electrical Characteristics of Wind Turbine Generators

GB/T 20322 Petroleum and Natural Gas Industries—Reciprocating Compressors

GB/T 20368 Liquefied Natural Gas (LNG)—Production, Storage and Shipping

GB/T 20850 Machinery Safety—Guidelines for the Application of Machinery Safety Standards

GB/T 24925 Cryogenic Valves—Technical Specifications

GB 25131 Safety Requirements for Vapour Compression Cycle Water Chilling (Heat Pump) Packages

GB/T 25285.1 Explosive Atmospheres—Explosion Prevention and Protection—Part 1: Basic Principles and Methods

GB/T 25357 Petroleum, Petrochemical and Natural Gas Industries—Positive Displacement Rotary Compressors for Process Use

GB 26410 Explosion-proof Ventilators

GB/T 28566 Grid Connection Safety Conditions and Evaluation for Generator Sets

GB/T 30554 Screw Expanders—Terminology

GB/T 30555 Acceptance Test Code for Performance of Screw Expanders (Units)

GB/T 31464 Power Grid Operation Code

GB/T 32238 General Carbon Steel Castings for Low-temperature Pressure-bearing Service

GB/T 32354 Technical Specifications for Screw Expanders (Units)

GB/T 33593 Grid Connection Technical Requirements for Distributed Generation

GB/T 35034 Technical Specifications for Safety Monitoring Devices of Screw Expanders (Units)

GB/T 37819 Low-temperature Waste Heat Dual-cycle Power Generation Units

GB/T 38109 Application Guidelines for Safety Accessories and Instruments of Pressure Equipment

GB/T 40286 Performance Test Methods for Low-temperature Dual-cycle Waste Heat Recovery and Utilization Units

GB/T 44045 Rotor Pumps for Petroleum, Petrochemical and Natural Gas Industries

GB 50016 Code for Fire Protection Design of Buildings

GB 50028 Code for Design of City Gas Engineering

GB 50057 Code for Design of Lightning Protection of Buildings

GB 50058 Code for Design of Electrical Installations in Explosive Hazardous Areas

GB 50150 Standard for Hand-over Test of Electrical Equipment of Electrical Installation Engineering

GB 50169 Code for Construction and Acceptance of Earthing Devices of Electrical Installation Engineering

GB 50183 Code for Fire Protection Design of Petroleum and Natural Gas Engineering

GB 50229 Standard for Fire Protection Design of Thermal Power Plants and Substations

GB 50257 Code for Construction and Acceptance of Electrical Installations in Explosive and Fire Hazardous Areas of Electrical Installation Engineering

GB 50260 Code for Seismic Design of Electric Power Facilities

GB/T 50493 Standard for Design of Combustible and Toxic Gas Detection and Alarm in Petrochemical Industry

GB 50556 Code for Seismic Design of Electrical Equipment in Industrial Enterprises

AQ 3009 Safety Code for Electrical Explosion Protection in Hazardous Locations

DL/T 1768 Preventive Test Code for Rotating Electrical Machines

HG/T 20613 Fasteners for Steel Pipe Flanges (PN Series)

NB/T 10090 Measurement of Airborne Noise Emitted by Screw Expanders and Driven Machinery

NB/T 11385 Screw Expanders—Hydrostatic Test Technical Specifications for Pressure-bearing Components

NB/T 11386 Screw Expanders—Rotor Dynamic Balancing

NB/T 11387 Screw Expanders—Measurement and Evaluation of Vibration

NB/T 42027 Screw Expanders—Technical Specifications for Pressure-bearing Steel Castings

NB/T 42036 Screw Expanders—Technical Specifications for Metallic Materials of Rotors

NB/T 42068 Screw Expanders—Ultrasonic Flaw Detection for Main Engine and Rotors

NB/T 42069 Screw Expanders—Technical Specifications for Packaging, Transportation and Storage

NB/T 47013.2 Non-destructive Testing of Pressure Equipment—Part 2: Radiographic Testing

SH/T 3038 Code for Electrical Design of Petrochemical Plants

SH/T 3097 Code for Design of Electrostatic Earthing in Petrochemical Industry

SH/T 3164 Code for Design of Lightning Protection of Instrument Systems in Petrochemical Industry

TSG 21 Safety Supervision Regulation for Stationary Pressure Vessels

3 Terms and Definitions

Those terms and definitions established in GB/T 30554 as well as the following ones apply to this document.

3.1 gross power output

The output power measured at the shaft end when a natural gas screw expander directly drives a generator or other mechanical equipment.

3.2 auxiliary power

The electric power consumed by all electrical equipment in a natural gas screw expander (unit).

3.3 net power output

The power obtained by subtracting the auxiliary power from the gross power output measured at the shaft end when a natural gas screw expander directly drives a generator or other mechanical equipment.

3.4 natural gas screw expander unit

A system consisting of a natural gas screw expander, pressure vessel, and directly driven mechanical equipment. It utilizes the pressure difference energy of natural gas to expand and do work directly inside the screw expander for conversion into mechanical energy, which in turn drives generators, fans, water pumps, and other mechanical equipment.

3.5 natural gas screw expander generator unit

A system consisting of a natural gas screw expander, generator, pressure vessel, and other components. It utilizes the pressure difference energy of natural gas to expand and do work directly inside the screw expander for conversion into mechanical energy to drive the generator for power generation.

3.6 explosive gas atmosphere

An atmospheric condition where a mixture of flammable substances (in gaseous or vapor form) and air can sustain self-propagating combustion after ignition.

4 Classification by Structural Types

4.1 Classification by Rotor Configuration

Natural gas screw expanders are classified into single-screw type and twin-screw type.

4.2 Classification by Lubrication Method

Screw expanders are classified into non-coolant-injected (oil-free) natural gas screw expanders and oil-injected natural gas screw expanders.

A non-coolant-injected (oil-free) natural gas screw expander, also referred to as a dry natural gas screw expander, is a helical rotary expander that does not use liquid to seal rotor clearances or rely on meshing rotors (rotors do not contact each other). Timing gears on the rotors ensure the meshing relationship between them, with the driving rotor driving the driven rotor via the timing gears.

An oil-injected natural gas screw expander is a helical rotary expander that operates without timing gears, where one

rotor drives the other directly. A lubricant compatible with natural gas is injected into the closed spiral position of the rotors in the expansion chamber.