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GIS 34-306

Natural Gas Engines

Group Instruction for Supply

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Engineering Technical Practice (ETP) GIS 34-306. This Group Instruction for Supply (GIS) is based on parts of heritage documents from the merged BP companies as follows:

British Petroleum

GS 134-8	Requirements for the Protection of Diesel Engines Operating in Zone 2 Hazardous Areas.
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Amoco

A RE-ENG-HS-G	Rotating Equipment-Engines-High Speed Gas and Diesel-Guide.
A RE-ENG-HS-P	Rotating Equipment-Engines-High Speed Gas and Diesel-Procurement Specification.

Gulf of Mexico Deepwater (GOMDW)

1400-20-ME-SP-2050	High Speed Diesel and Gas Engines.
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PTA

PTA RE-ENG-HS-G	Rotating Equipment-Engines-High Speed Gas and Diesel-Guide.
PTA RE-ENG-HS-P	Rotating Equipment-Engines-High Speed Gas and Diesel-Procurement Specification.

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1. Scope

This GIS provides requirements for design, materials, fabrication, inspection, testing, documentation, and preparation for shipment of gas engines fuelled by natural gas, such as butane or propane. Dual fuel (natural gas and diesel) engines are not included in this GIS.

2. Normative references

The following referenced documents may, to the extent specified in subsequent clauses and normative annexes, be required for full compliance with this GP:

- For dated references, only the edition cited applies.
- For undated references, the latest edition (including any amendments) applies.

BP

GIS 06-601	Painting of Metal Surfaces.
GIS 15-011	Noise Control.
DS 34-306	Data Sheet for Natural Gas Engines.
ITP 34-306	Vendor Inspection and Testing Plan for Natural Gas Engines.
VDR 34-306	Vendor Data and Drawing Requirements for Natural Gas Engines.
GIS 34-503	Special Purpose Couplings (API 671).

American Bureau of Shipping (ABS)

ABS Publication # 0006 Rules for Building and Classing Mobile Offshore Drilling Units.

American Gear Manufacturers Association (AGMA)

ANSI/AGMA 9002-B04 Bores and Keyways for Flexible Couplings (Inch Series).

American Society of Mechanical Engineers (ASME)

ASME B31.3 Process Piping.

European Parliament and The Council (EC)

Directive 94/9/EC Equipment intended for use in Potentially Explosive Atmospheres (ATEX).

European Standard

EN 13463	Non-electrical equipment for potentially explosive atmospheres. All parts.
EN 60079	Electrical apparatus for explosive gas atmospheres. All parts.

International Electrotechnical Commission (IEC)

IEC 60079 Electrical apparatus for explosive gas atmospheres - All parts.

International Organization for Standardization (ISO)

ISO 1940-1 Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state - Part 1: Specification and verification of balance tolerances.



ISO 3046-1	Reciprocating internal combustion engines - Performance - Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods - Additional requirements for engines for general use.
ISO 10816-6	Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts - Part 6: Reciprocating machines with power ratings above 100 kW.
ISO 15550	Internal combustion engines - Determination and method for the measurement of engine power - General requirements.

National Fire Protection Association (NFPA)

NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
NFPA 70	National Electrical Code (NEC).

3. Symbols and abbreviations

For the purpose of this GIS, the following symbols and abbreviations apply:

BMEP	Brake mean effective pressure.
LHV	Lower heating value.

4. Technical requirements

- a. Technical requirements for separable high speed natural gas engines (600 rpm or greater) are based on engine manufacturer standard design. This GIS provides additional requirements.

This GIS encourages a standard package in which all auxiliary systems (except main cooler) are engine mounted. Reliable and compatible auxiliary systems are usually provided by Vendor and are not specified in detail.

- b. Equipment noise levels shall comply with GIS 15-011.
- c. Design and mechanical construction of engines, accessories, and auxiliary system components shall have at least 16 000 hr of field operating service.
- d. Unless specified otherwise, engines shall be rated for continuous service.
- e. Engines rated for continuous service shall be designed to operate in excess of 8 000 hr/yr with minimum uninterrupted periods of 1 000 hr.
- f. Current turnkey overhaul cost shall be provided as follows:
 1. Major and minor overhauls shall be included.
 2. Parts and labour shall be listed separately.

Continuous and intermittent performance classifications are commonly used by BP. The following are general criteria for each:

- *Continuous duty engines operate at least 8 000 hr/yr and operate for uninterrupted periods of 1 000 hr or more.*
- *Intermittent duty engines operate less than 1 500 hr/yr and operate at rated kW (bhp) for 4 hr in any 24 hr period, then operate at or below continuous kW (bhp) rating.*



- g. Engines shall be of current manufacture with spare parts readily available.

In a money saving exercise, some projects have purchased outdated machinery, resulting in consequent trouble in sourcing spare parts.

5. Performance

5.1. Standard conditions and fuel heating values

The following standard conditions shall be used for engine rating:

- a. Standard reference conditions are defined in ISO 15550, 2002, clause 5.
- b. Standard fuel gas shall be 90% methane, minimum, and have LHV of 34,3 MJ/m³ (920 Btu/ft³).

Three sets of operating conditions for specifying and evaluating a gas engine are:

- *Standard conditions in accordance with this GIS.*
- *Standard conditions as defined by Vendor.*
- *Site conditions where engine will be installed.*

5.1.a and 5.1.b specify operating conditions and require Vendor to calculate (horse)power for proposed engine for these conditions. This requirement establishes common base for engine (horse)power evaluation, whereas vendor standard conditions vary and cannot be used to make meaningful comparisons.

Site conditions normally differ from BP specified standard conditions. Site conditions should be defined and entered on data sheet, because they affect engine rated (horse)power.

Site conditions have significant effect on selection of engines and auxiliary systems. If selecting engines and air coolers, maximum ambient temperature should be highest temperature that is exceeded only 3% of the time. Critical concerns are rated ambient temperature and emission control.

5.2. Performance correction

5.2.1. Standard to site conditions

- a. (Horse)power corrections for temperature and altitude from standard conditions to site conditions shall comply with ISO 3046-1:2002.
- b. Allowable kW (bhp) should be 90% of rated kW (bhp) at site conditions.

This derating:

- *Should be applied to engines, regardless of service.*
- *Allows for variations in test tolerances (typically $\pm 5\%$), site fuel quality, off design conditions, and normal wear. This is necessary because Vendor (horse)power rating does not consider test tolerances or site specific variations.*

Most vendors do not guarantee site performance because of variance in conditions. However, they do guarantee test stand performance corrected to site conditions by agreed upon derating criteria.

Values for ambient temperature and barometric pressure become less significant if intake air is compressed by supercharger or turbocharger, because superchargers and turbochargers increase inlet air pressure and temperature. Net pressure and temperature increase depend on vendor design. Therefore, (horse)power corrections for supercharged or turbocharged engines should be made by Vendor.

