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Guidance on Practice for Boilers and Auxiliaries

GP 56-10

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 56-10. This Guidance on Practice (GP) is based on parts of heritage documents from the merged BP companies as follows:

Amoco

A FE-BFW-TRTG-E	Fabricated Equipment Boiler Feedwater Treating Equipment Engineering Specification.
A-FE-BFW-TRTG-G	Fabricated Equipment Boiler Feedwater Treating Equipment Guide.
PTA FE-BLR-00-E	Fabricated Equipment Boilers / Steam Generators Engineering Specification.
PTA FE-BLR-00-G	Fabricated Equipment Boilers / Steam Generators Guide.

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1. Scope

- a. Boilers
 - 1. This GP defines technical requirements for specification, selection, and system design for boilers and auxiliary equipment.
 - 2. This GP includes shop fabricated (packaged) boilers and field constructed (custom) boilers.
 - 3. This GP is applicable to fired, fired tube, and unfired boilers, as well as water tube boilers, fired boilers, and waste heat boilers.
- b. Auxiliary equipment for boilers
 - 1. This GP defines technical requirements for design and specification of purification equipment for boiler feedwater treatment.
 - 2. This GP includes chemical systems, such as:
 - a) Clarification equipment.
 - b) Pressure filters.
 - c) Ion exchange equipment.
 - d) Hot lime softeners.
 - e) Chemical feed equipment.
 - f) Lime systems.
 - g) Coagulant systems.
 - h) Acid systems.
 - i) Caustic systems.
 - j) Brine systems.
- c. This GP does not include all safety requirements for chemicals used in boiler feedwater treatment.
- d. This GP does not include reverse osmosis (RO), ultrafiltration (UF), flash evaporation, or electrodialysis reversal.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

DS 46-010	Pressure Vessels
GIS 12-201	IEC Low Voltage Induction Motors
GIS 12-202	NEMA Low Voltage Induction Motors (PIP-ELSMT01D)
GIS 46-010	New Pressure Vessels Procurement Requirements
GIS 56-101	Shop Fabricated (Packaged) Boilers.

GIS 56-102	Field Constructed (Custom) Boilers.
GIS 56-104	Boilers: Feedwater: Hot Lime Softeners
GIS 56-105	Boilers: Feedwater: Ion Exchange
GIS 56-106	Boiler Deaerator
GIS 56-107	Boilers: Feedwater: Pressure Filters
GIS 56-108	Boilers: Feedwater: Clarification Equipment
GIS 62-016	GIS Generic Information (Ball, Gate, Plug)
GIS 62-117	GIS Generic Information (Gate, Globe)
GIS 62-028	General Valve Procurement Information
GIS 62-041	Relief Valves
GP 4-20	Civil Engineering
GP 6-10	Corrosion Protection Management Guidelines
GP 6-60	Onshore and Offshore Paints and Coatings
GP 6-63	Internal Coating of Equipment and Piping
GP 18-01	General Requirements for Welded Fabrication
GP 34-00	Rotating and Machinery Equipment
GP 36-10	Engineering Guidance on Materials Selection
GP 42-10	Metallic Piping Systems ASME B31.3
GP 44-80	Design Guidelines for Relief Disposal Systems
GP 46-01	New Pressure Vessels
GP 52-10	Thermal Insulation
GP 60-14	Demineralizer System
GP 60-50	General Issues – Equipment Packages
GP 62-04	Relief Valves

American Petroleum Institute (API)

API Spec 12D	Specification for Field Welded Tanks for Storage of Production Liquids.
API Spec 12F	Specification for Shop Welded Tanks for Storage of Production Liquids.
API Std 650	Atmospheric Storage Tanks.

American Society of Mechanical Engineers (ASME)

ASME Sect VIII	ASME Boiler and Pressure Vessel Code, Rules for Construction of Pressure Vessels, Division 1.
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National Fire Protection Association (NFPA)

8501	Standard for Single Burner Boiler Operation.
8502	Standard for the Prevention of Furnace Explosions / Implosions in Multiple Burner Boilers.

Occupational Safety & Health Administration (OSHA)

OSHA 1910	Working-Walking Surfaces, Subpart D
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3. Symbols and abbreviations

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

BFW	Boiler feedwater.
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EDI	Electro deionisation reversal.
EPRS	Effective projected radiant surface.
ERW	Electric resistance welded.
ID	Inside diameter.
MAWP	Maximum allowable working pressure.
NPSH	Net positive suction head.
P&ID	Piping and instrumentation diagram.
PMI	Positive material identification.
RO	Reverse osmosis.
UF	Ultrafiltration.

4. General

4.1. Conflicts

In event of conflict between this document and any references, governing requirement shall be obtained in writing from BP.

4.2. Electrical area classification

Boiler electrical shall comply with GP 12-60.

Boiler Vendors routinely design equipment for unclassified areas. If area is classified, proper specification of electrical components should be ensured.

4.3. Scope of supply

- a. Boilers shall comply with GIS 56-101, GIS 56-102, GIS 62-116, GIS 62-117 and GIS 62-028.
- b. Deaerators shall comply with GIS 56-106 and GP 6014 using DS 46-010 and applicable drawings.
- c. Additional job specific requirements shall be subject to BP approval.
- d. Code section used in stamping shall be subject to BP approval.
- e. Boiler Vendor scope of supply showing code boundaries shall be subject to BP approval.
- f. Areas marked with asterisk (*) on data sheet shall be specified.

5. Boilers

5.1. Selection

5.1.1. Shop fabricated (packaged) boilers

Package boiler generator defined here is typically a boiler in which all internal steam generating components except superheater or economiser are built as single shop assembled unit and capable of being shipped to job site on rail car.



Package boilers tend to be pre-engineered designs for pressure, temperatures, and capacities that may not exactly match requirements of application but are lower in price. Since package boilers are pre-engineered, it is often costly and difficult to make changes to design.

- a. BP should review any package boiler as to acceptability of design and shall use GIS 56-101 as the minimum specification for package boilers. Engineer should evaluate project needs against cost of modification.
- b. If economically feasible, requirements in GIS 56-102 should be incorporated into package boilers.
- c. Each requirement should be evaluated on its own merit.
- d. In particular, if unit is not already fabricated, sections relating to inspection and test should be applied to package boilers.
- e. If proposed package boiler is unacceptable, custom designed boiler generator should be substituted.

Package boilers typically have high heat fluxes that can restrict type of water used. They are also difficult to maintain due to limited maintenance access to pressure parts.

Constraints such as timing and cost, weighed against rigidity of steam requirements and location needs, may dictate necessity to waive requirements of GIS 56-101 entirely and purchase off the shelf unit.

5.1.2. Field constructed (custom) boilers

Custom boilers can be stick built, shop fabricated modular design, or mounted on skid. Designs shall meet process parameters unique to application.

Normally, applications for high pressure (greater than 62 barg [900 psig]) or waste heat employ custom boiler designs.

5.2. Waste heat gases

- a. If waste heat gases are used to provide or supplement heat for boiler, the waste heat gas flow into the boiler requires modelling and the results shall be reviewed by BP.
- b. If required, modelling should resolve location of flow deflectors, perforated plates, or similar flow straightening devices to ensure distribution of gases and / or particulates.

5.3. Performance design

5.3.1. Boilers

- a. The following shall be obtained from BP or defined and specified:
 1. Feedwater supply location, temperature, pressure, and chemical analysis.
 2. Fuels or sources of heat.
 3. Ambient conditions of local weather and elevation above sea level.
 4. Environmental permitting restrictions.
 5. If package is boiler, dry steam requirements.
- b. BP should relate conditions at Vendor discharge location to steam conditions required at locations, such as downstream equipment or steam main lines.
- c. Feedwater supply location, temperature, pressure, and chemical analysis, as well as fuels or sources of heat, shall be similarly defined.



- d. Special operating conditions for boiler shall be defined.

Although guarantee is based on single design condition, there are often alternate conditions designer needs to ensure equipment can successfully handle. For example, boiler may normally be designed for 100% steam flow, but part of the time it may be required to run at 30% flow yet maintain steam conditions. Therefore, superheater may have to be enlarged for lower flow case and be controlled differently at 100% flow operation.

"Firing Rate" columns on page 1 of boiler data sheet can communicate this to boiler Vendor. First column is meant to reflect guarantee condition, while other columns reflect alternate designs for differing conditions, such as steam rates, different fuels, or operation without air preheaters / economisers.

Boiler furnace heat release limits may be relaxed to comply with environmental restrictions. This option may avoid over sizing boiler.

For particulate laden gas streams, regulating velocity of gas is important. Normally, velocity of 9 m/s (30 ft/s) to 15 m/s (50 ft/s) is desired. Velocities lower than this result in larger than desirable boilers due to poor heat transfer rates. Higher velocities can result in erosion of tubes or refractory linings.

- e. Current applicable environmental rules and regulations shall be reviewed to determine if lower heat flux based on effective projected radiant surface (EPRS) than that specified in GIS 56-101 or GIS 56-102 is warranted.
- f. Pollution control equipment shall achieve mandated design emission levels.
- g. Operating requirements for steam purity, pressure, temperature, water quality, and flow shall be obtained from BP and shall be subject to BP approval.

If calculated by model for boiler performance, maximum fluid temperature may not be precisely known. If not precisely known, adding margin to maximum fluid temperature provides method of dealing with inadequacy of heat transfer / fluid mechanics models used by boiler Vendor and imperfect nature of water treatment. Since performance will change over life of boiler, it may be prudent to set design temperature with margin for error. Maximum margin of 10°C (50°F) is normally sufficient.

- h. Startup, shutdown, and special operating conditions, such as rapid load changes and standby operation, shall be subject to BP specification and approval.
- i. Lowest operating load ensuring safe steam and water flow through boiler tubes shall be subject to BP specification and approval.

5.3.2. Auxiliaries

- a. Equipment performance, such as flow rate, process stream analysis, and utility requirements, shall be defined.
- b. Vendor scope of supply will be defined.

BP process engineer should require that water treatment equipment Vendor define performance of equipment considering entire range of water quality likely encountered. Sufficient testing or use of historical data to define range of inlet water quality should be obtained.

- c. Vendor shall comply with local and national environmental restrictions. Such restrictions will be provided to Vendor.
- d. Special operating conditions, e.g., startup, shutdown, rapid load changes, standby operation, shall be defined.

