DESIGN SPECIFICATIONS AND STANDARD

Note:

Information contained in this note is strictly for learning and teaching and not for any commercial purpose. Authors and websites whose works are copied to add value to this lecture note are acknowledged by way of references.

1.0 Design Specifications

A **design specification** is a detailed document providing a list of points regarding a product or process. For example, the **design specification** could include required dimensions, environmental factors, ergonomic factors, aesthetic factors, maintenance that will be needed, materials requirement, performance specifications, test specifications, etc.

The design specification should provide a clear and unambiguous definition of the outcomes to be achieved. Design requirements are formally defined; often in terms of constraints that must be met for the solution to be feasible, and objectives by which the performance of a feasible design is ranked.

A design specification is specific to a particular project. Standards are made reference to and incorporated in design specifications.

1.1 Final design Specification (FDS)

An FDS must include all necessary drawings, dimensions, environmental factors, ergonomic factors, aesthetic factors, costs, requirements, quality, safety documentation, and disposal methods. This specification is the culmination of all the design work that has led to the concept and the detailed design work that has converted the concept into a practical design. The FDS should be a complete set of instructions on how to build and use the product.

For simple products such as an electric alarm clock, the FDS may be a one-page document that outlines power consumption and instructions for use. In the case of a ship, for example, the document may run into many thousands of pages outlining the working requirements, maintenance requirements, and all necessary information relating to the millions of components that contribute to the efficient working of the ship.

Typical example of design specification is shown in Table 1.

Table 1: Stirred batch pulper design specification (source: Manyuchi, 2015)

Number required	4
Height	4.34 m
Nominal diameter	2.17 m
Volume	16 m^3
Nominal pulper thickness	0.022 m
Number of heating coils	8.4
Design pressure	1 167 kPa
Jacket thickness	0.30 m
Material of construction	Carbon steel
MECHANICAL ENGINEERING DESIGN	
Weight of contents	1 876 kN
Maximum bending moment	21.3 kNm
Maximum compressive stress	1.931 kN
Wind load	1.572 kN

2.0 STANDARDS

2.1 Introduction

What are standards?

Standards are an important part of our society, serving as rules to measure or judge capacity, quantity, content, extent, value and quality. Some standards take the form of an actual item such as the atomic clock which serves as the reference for measuring time throughout the world. Others set criteria for use and practice in industry and for products used in everyday life. Standards must be addressed before any engineering design project can be started.

2.1 About Standards Organisation of Nigeria (SON)

The STANDARDS ORGANISATION OF NIGERIA (SON) is the apex standardization body in Nigeria. SON was established by SON Act No. 14, 2015, which repeals the Standards Organisation of Nigeria Act, Cap 59 laws of Federal Republic of Nigeria, 2004, and Enact the

STANDARDS ORGANISATION OF NIGERIA Act. 2015 for the purpose of providing additional functions for the organisation, increasing penalty for violation, and for related matters.

This SON Act 2015, has now replaced the Enabling Act No. 56 of 1971 which has three amendments: (Act No. 20 of 1978, Act No. 32 of 1984 and Act No. 18 of 1990).

The aims and objectives of the SON include:

1. Preparation of standards relating to products, measurements, materials and processes among others, and their promotion at the national, regional and international levels;
2. Certification of industrial products;
3. Assistance in the production of quality goods;
4. Improvement of measurement accuracy and circulation of information relating to standards.

2.2 How are standards developed?

The International Standards Organization (ISO) coordinates standards world-wide. Under this umbrella are representative organizations from many countries; for the U.S., it is the American National Standards Institute; for Nigeria, it is Standards Organisation of Nigeria, etc. Some standard issuing organization are listed in Table 2.

Table 2: Standards-issuing organization ACRONYMS

AIA	Aerospace Industries Association of America
AAI	Aluminum Association, Inc
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers

ASTM	American Society for Testing and Materials
AISE	Association of Iron and Steel Engineers
BOCA	Building Officials and Code Administrators
BSi	British Standards
ISO	International Organization for Standardization
MIL SPEC	United States Military
NFoPA*	National Forest Products Association (now AFPA, American Forest and Paper Association)
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
BIS	Bureau of Indian Standards

2.3 **How does the numbering system for standards work?**

There are almost as many different ways of numbering standards as there are standards-issuing organisations, although many follow a similar format. First comes the acronym of the organization which issued the standard. For example, ASTM comes before those standards originating from the American Society for Testing and Materials. This is usually followed by a letter designation that denotes the general classification of the standard. ASTM uses letters to denote certain materials:

• A -- ferrous metals and products
• B -- nonferrous metals and products
• C -- cementitious, ceramic, concrete and masonry materials
• D -- miscellaneous materials and products
• E -- miscellaneous subjects
• F -- end-use materials and products
• AG -- corrosion, deterioration, weathering, durability and degradation of materials and products
• ES -- emergency standards.

A sequential number follows the letter. If the standard is written using metric units but has a companion standard in inch-pound units (or any other type of units), it is then followed by an M to identify the metric standard. Next, usually following a hyphen, is either the full year in which the standard was issued or else the last two numbers of that year (89 for 1989). Some organizations will change this number to indicate the year in which the standard was last revised; others place this information in parenthesis after the title of the standard. Should the year be followed by a lower case letter, it indicates that there was more than one revision of the standard during that year ("a" indicates the second revision, "b" indicates the third, etc.). An example of an ASTM standard is standard ASTM F468M-93: Nonferrous Bolts, Hex Cap Screws and Studs for General Use (Metric). As you can see, using the information in the previous paragraph, the number itself provides an enormous amount of information. We know just by looking at it that the standard to which it refers is issued by the American Society for Testing and Materials, that it deals with an end-use material or product, and that it is written using metric units.

2.4 Some Examples of Standards

- ASTM E8M. “Standard Test Method for Tension of Metallic Materials (Metric)
- ASTM D 3184-89 Standard Test Method for Rubber - Evaluation of Natural Rubber (Natural Rubber).
- ASTM D 412-06a Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- ISO 2884-2:2003, *Paints and varnishes -- Determination of viscosity using rotary viscometers -- part 2: disc or ball viscometer operated at a specified speed*. 2003
- NIS 269: 1989: *Standard for paints and varnishes; part 5: specifications for emulsion paints for decorative purposes.* 1989.
- BS 5950
- **BS EN 13445: 2002 - Unfired pressure vessels**
- **BS 5400:2000 - Steel, concrete and composite bridges**
- **BS EN 13001:2004 - Crane safety. General design**
- BS 4449:1998: Standard for Steel test

2.5. Assignment for Students

1. **Briefly** explain **ten (10)** reasons why specifications are important in engineering.

2. Briefly outline 10 things that must be contained in product/process design specification.

3. Each of the departments in the faculty should down load or get any standard relevant to their field. Study the standards. Each department should send five (5) representatives to make a short presentation about the downloaded standard. You will submit a copy of the standard and your presentation. During submission, bring your class list for the purpose of scoring.

All assignments and presentation will be submitted on February 23, 2021 by 10 am.

References

1. https://en.wikipedia.org/wiki/Design_specification#:~:text=A%20design%20specification%20is%20a,that%20will%20be%20needed%2C%20etc.
2. Anthony Johnson, Andrew Gibson, Chapter 2 - Design Approach, Philosophy, and Normal Approach Design Model, Editor(s): Anthony Johnson, Andrew Gibson, Sustainability in Engineering Design, Academic Press, 2014, Pages 21-63, ISBN 9780080993690, https://doi.org/10.1016/B978-0-08-099369-0.00002-9.
3. **Martin Leary, Chapter 3 - Digital design for AM, Editor(s): Martin Leary, In Additive Manufacturing Materials and Technologies, Design for Additive Manufacturing, Elsevier, 2020, Pages 33-90, ISBN 9780128167212, https://doi.org/10.1016/B978-0-12-816721-2.00003-8.**
4. Georginna Lucas and Lisa Hatcher , Introduction to Standards and Specifications for Design in Mechanics or Strength of Materials

5. Musaida. M. Manyuchi., Auxilliah. T. Chiwanga and D. J. Nkomo , **Techno-economic analysis for virgin paper production from bagasse,** *8th Zimbabwe Institute of Engineers Congress-September 14-19, 2015 – Victoria Falls, Zimbabwe* (2015).
6. www.son.gov.ng