International Association of Oil & Gas Producers

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Guidance on requirement development

Acknowledgements

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About

Projects in the energy industry are large and complex, and project execution can be negatively affected by unclear or ambiguous technical requirements. Greater precision in the drafting of requirements for use in the energy industry will make projects easier to manage and reduce risk. This guidance draws from good practices across the industry and has been applied by some Member Companies and in IOGP JIPs to improve the quality of technical writing. This guidance, supported by training and appropriate review processes, is recommended to be applied by standards developing organizations to prepare technical content for effective digital application.

Feedback

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Revision history

VERSION	DATE	AMENDMENTS
2.0	November 2022	Updated definitions for characteristics of a good requirement (Section 1). Updated standard technical writing conventions and content types (Sections 2 and 3). Replaced examples of well and poorly written requirements (Section 4).
1.0	February 2021	First release

Contents

Introduction

The objective of this guidance is to deliver requirements in IOGP JIP33 and other IOGP specifications that are consistent, promote standardization, and are ready to be digitized.

This guidance draws from good practices across industry and is closely aligned with the following documents on technical writing:

- INCOSE, Guide for Writing Requirements, INCOSE-TP-2010-006-02, Rev. 2
- ISO/IEC Directives, Part 2: Principles and rules for the structure and drafting of ISO and IEC documents

Energy projects are large, complex, and involve many participants. Project execution is impacted by the clear definition of technical requirements and the smooth transfer of information through the supply chain.

Technical standards and specifications have tended to be a mixture of narrative, guidance, and prescriptive content. The ambiguity arising from this mixture increases uncertainty and risk and can be difficult to manage. One improvement that the energy industry can make now is to be more precise in defining requirements.

Moreover, an examination of the digital management of requirements has highlighted that improvements are needed in non-digital aspects. Digital systems can help with the organization, processing, and communication of content, while better requirement writing practices will facilitate digitalization and better decision making.

This guidance has been applied by some IOGP Member Companies to improve the quality of technical writing. This guidance, supported by training and appropriate review processes, is recommended to be applied by standards developing organizations to prepare technical content for digital application.

1. Characteristics of a well written requirement

The table below lists criteria for well written requirements. A definition of each criterion in a requirements writing context is provided, along with considerations for those writing requirements. The considerations include rhetorical questions, examples of a well written requirement, and advice on sentence construction.

Table 1: Criteria, definitions, and considerations for writing good requirements

Criteria	Definition	Considerations, examples, and rationales
Necessary	Adds specific value to business delivery. If not included, a deficiency in capability will exist which cannot be fulfilled by implementing other requirements.	• Does this requirement manage process safety risk, or personal safety risk? • Does this requirement manage the risk of an environmental incident? • Does this requirement deliver target integrity, reliability, and operability? • Does this requirement deliver the target lifecycle cost? • Does this requirement decompose the functionality of a higher level requirement, or summarize functions from lower level requirements? • What would happen if the requirement was removed? What would be the impact on safety, reliability, operational performance, lifecycle cost? • Is the requirement a preference rather than a necessity? Reference to a non-industry internal organization or role may indicate that the requirement is a preference.
Feasible	Can be achieved within known constraints (e.g., technical, legal, cost, schedule)	• Can the requirement be implemented within known constraints? • If absolutes are included, test that the absolutes are feasible and verifiable, e.g., 6 years between overhauls. Ensure feasibility is aligned with industry capability. • Avoid aspirational requirements.
Verifiable	Structured and worded such that its realization can be proven (verified) to the customer's satisfaction.	• Each requirement is verifiable • Terms can be defined. Vague terms may result in risk and cost that were not what were intended. • Avoid non-measurable quantifiers, e.g., "readily", "clearly", "proven", "early life", "efficiently", "enough", or "medium-sized". • Avoid non-specific temporal terms, e.g., "eventually", "later", or "brief".

Criteria	Definition	Considerations, examples, and rationales
Unique	Requirements are unique.	• Each requirement has an ID so that the requirement can be uniquely identified. • In a digital environment, requirements can be stored once and reused rather than referenced. • Requirements cannot contradict each other.
Subject	The single thing to which the requirement refers.	• The subject could be the function, person, system, or subsystem.
Singular	State a single capability, characteristic, constraint, or quality factor. Avoid use of "and".	• A single requirement reduces ambiguity and conflict. This criterion is essential for digitalization where verification, information, and attributes are linked to requirements. • Each requirement usually has only one shall statement. • Lists: - Avoid lists of independent requirements, e.g., a lead in statement "the system shall contain the following", followed by a list of 10 different and independent requirements. - Circumstances when lists are acceptable include listing options. For example, the statement "the system shall meet one of the following", followed by a list of possible qualifying conditions, is acceptable. **Example of an acceptable list:** Cable trays, channel and ladder trays shall be one of the following: • Copper free aluminium • Fibreglass

Criteria	Definition	Considerations, examples, and rationales
Clear and Concise	Stated in such a way that it can be interpreted in only one way. Avoid placing rationale statements in requirement statements.	• Avoid complex sentences (those with a dependent clause) and other sources of ambiguity. Complex sentences are prone to misinterpretation at point of use. • Use active form to create shorter sentences with clarity on subject and outcome. Minimize use of passive form. • A guide for the number of words per sentence is 25. More than 25 is acceptable but clarity of requirement should be checked. • Conditional constructs (if, unless, etc.) should be avoided. Where a conditional construct is used, the condition should be at the beginning of the sentence. • Avoid multiple conjunctions. **Example before:** During impending adverse weather conditions, ongoing surface preparation shall be suspended if painting cannot be completed in one go and paint cannot dry as required to withstand weather damage. **Example after:** If impending weather conditions could interrupt paint application and drying, surface preparation shall be suspended. • Limit use of unnecessary words and universal qualifiers such as "a", "all", "any", each", "every", "the", "often". If appropriate, replace with specific values. **Example before:** Every high-voltage switching device shall have sets of volt free auxiliary contacts. **Example after:** High-voltage switching devices shall have sets of volt free auxiliary contacts. • Avoid use of 'etc.' because it is inherently ambiguous. • Minimize use of cross-referencing pronouns, e.g., "it", "this", "that", to avoid ambiguity on subject or object. Instead, repeat nouns in full to refer to nouns in other requirements.

2. Standard technical writing conventions

2.1 Overlay and narrative styles

Specifications can be overlay or narrative style.

Overlay style specifications are aligned with and make exceptions to industry standards. Clause numbering mirrors the industry standard. Requirements in overlay style specifications occur for one of four reasons.

- Amending a clause in the industry standard. Amendments include:
  - Add to existing text
  - Replace content in a clause
  - Add new content
  - Delete existing text

  To avoid ambiguity, it may be necessary to be specific about which text is being amended, e.g., "Replace second sentence beginning 'The purchaser shall '...' with: '.....' ".
- Selection of optionality in industry standards, e.g.:
  - While the standard provides options A, B or C, the operator wants to specify one option only
  - A standard includes a requirement subject to purchaser's discretion, and the purchaser does not want the requirement
- Responses to "Purchaser to specify" type statements in the industry standard
- Not covered by the industry standard

Narrative style specifications are standalone and have sequential clause numbering. Narrative style specifications do not mirror industry standards, but industry standards can be referenced.

2.2 Notes

Use notes for information and context related to the requirement.

Do not include requirements or recommendations in notes.

Keep notes to a minimum.

Requirements and recommendations should be useable without notes.

2.3 Tables, figures and equations

Do not include requirements or recommendations in tables, figures, and equations.

Number and label all tables, figures and equations and reference them by number (instead of 'below'). For exception style documents, follow the numbering style of the source standard while making sure there is no conflict, such as two figures with the same number.

For narrative style documents, number tables in the order they appear.

Do not put tables inside tables.

2.4 Headings

2.4.1 Heading structure

Hierarchy of headings should only be used to identify where a requirement applies in the context of the higher-level system.

Example:

2 Corrosion controls
2.1 Onshore arid
2.2 Onshore marine
2.3 Offshore

2.4.2 Subheadings

Do not put requirements under a heading that is followed by a subheading. The example below shows correct placement of shall statements.

Example:

4 Speed governing
4.1 Governor
a. Engine governor shall be mechanical.
b. Set points shall be manually adjustable.
4.2 Speed indication
a. Independent method of detecting overspeed shall be provided.
b. Control range signal characteristics shall be specified.

2.5 Use of shall, should, and may

2.5.1 Requirement clauses

Use 'shall' in requirement clauses. Avoid implied requirements, e.g., do not use 'will', 'needs to', 'must' or 'is to be', to imply requirements.

Use "will", "could" or "might" for informative text (notes). Do not use "shall" in informative text.

2.5.2 Recommendation clauses

Use 'should' in recommendation clauses.

Do not use "should" in specifications that will be used as part of a bid or procurement cycle. Recommendation clauses increase uncertainty in outcomes because there is no contractual obligation for a should.

Design specifications can include 'should' statements if they enable optimal solutions that balance conflicting drivers.

2.5.3 Permission clauses

Use 'may' in permission clauses.

Limit the use of "may" in specifications that will be used as part of a bid or procurement cycle, or in design specifications.

Example:

Painting may be done at a sub-supplier.

2.5.4 Definition of 'requirement'

Per ISO/IEC Directives Part 2: "[Requirement] conveys objectively verifiable criteria to be fulfilled and from which no deviation is permitted if conformance with the document is to be claimed."

Some companies have processes to manage deviations. In addition, overlay style specifications are used by some companies to manage changes to industry standards.

2.5.5 Definition of 'recommendation'

Per ISO/IEC Directives Part 2: "[Recommendation] conveys a suggested possible choice or course of action deemed suitable without necessarily mentioning or excluding others." Recommendation is expressed by the use of "should".

2.5.6 Definition of 'permission'

Per ISO/IEC Directives Part 2: "[Permission] conveys consent or liberty (or opportunity) to do something. Permission is expressed by the use of "may". "May" is not used as the normal linguistic way in English (might or could)."

2.6 Scope of document

Per ISO/IEC Directives Part 2, a scope is a mandatory and normative element of a document. A document's scope shall not contain requirements, recommendations, or permissions.

2.7 Organizational references

Avoid organizational references, especially those that may be company specific, e.g., "Approval shall be obtained by XYZ Quality department."

2.8 Single audience

Avoid assigning responsibility to a supplier or manufacture on a requirement by requirement basis. Use of the term "manufacturer" is acceptable if used as an adjective.

Example:

"Preparation for shipment shall be in accordance with Manufacturer's standards...." does not assign responsibility to the manufacturer.

Example:

"For busbar earthing via withdrawable truck mounted earthing switch, the Manufacturer shall provide one earthing truck for each HV switchboard assembly," does assign responsibility to the manufacturer. To avoid assigning responsibility, the requirement could be rewritten as: "For busbar earthing via withdrawable truck mounted earthing switch, one earthing truck shall be provided for each HV switchboard assembly."

2.9 Use case

The use case for specifications should be defined in a scope or similar section so that the specification is applied correctly.

2.10 Numbering

Headings and sub-headings should be numbered.

Requirements, recommendations, and permissions should have individual numbers or identifications.

List of conditions that apply to a single requirement may be numbered.

2.11 Use of datasheets

Datasheets define individual design cases. Equipment and services are designed, purchased or built to the parameters in the datasheets.

Decision points in a standard can be resolved in the datasheet.

2.12 Discretionary statements

For equipment specifications, avoid using statements that depend on choices. It is expected that a specification will have defined the applicable requirements for the removal of discretionary or contradictory content before issuing to recipient. Common examples of statements to avoid include:

- "unless otherwise specified" or "unless otherwise specified by the purchaser"
- "unless otherwise agreed" or "as "otherwise agreed with the purchaser"
- "requirements subject to owners' discretion"
- "requirements subject to purchaser approval"

If such requirements are defined in the parent standard and are material to the clarity of the requirement, consider the following options:

- If an option or input value needs to be defined by the purchaser, it needs to be managed as a datasheet attribute and the clause amended to read "as specified in the datasheet"
- Delete "unless otherwise specified" so the specifier or supplier makes a conscious decision to deviate from the requirement and manages the change via tender clarification, technical query, or contract amendment.

2.13 Rationale

It is good practice to include a rationale to briefly define why the requirement is necessary.

The rationale confirms the validity of the requirement as being necessary, typically clarifies the intent of the requirement to aid with interpretation, and captures the knowledge of why the requirement was added.

In a digital environment, a rationale can be included as an attribute to a requirement. For specifications that are not managed in a digital tool, a rationale can be included as an informative annex.

2.14 References

If a requirement is expressed by referring to an industry standard or other document, list the reference in a reference clause.

3. Content types

3.1 Normative and informative content

Content can be normative or informative.

Normative clauses contain shall, should, or may statements. In addition, a scope is considered a normative element.

Informative clauses help the understanding or application of content. Informative clauses do not contain requirements, recommendations, or permissions. Examples of informative content are notes, rationale, guidance, and informative appendices.

3.2 Engineering specifications for design or equipment procurement

Normative clauses in engineering specifications for design or equipment procurement define characteristics that can be demonstrated in the final product. A technical review process that results in a deliverable such as classification, criticality rating, etc., is also considered a technical normative clause. Examples include functional safety assessment and HAZOP.

Commercial and contractual normative clauses are typically not included in engineering specifications for design or equipment procurement. However, there might be justification for inclusion to define a condition of a technical clause or order of precedence. Commercial and contractual clauses that overlap with elements of a standard contract, e.g., warranties or quality management approaches, should be avoided. Commercial and contractual terms are not included in industry standards.

Normative clauses to be carried out when equipment is in service and not related to design or handover are typically not included in engineering specifications for design or equipment procurement.

4. Examples of well written and poorly written requirements

Table 2: Examples of well written and poorly written requirements

Characteristic	Poorly written example	Well written example	Comment
Content type		Permanently affixed pointer shall identify which piece of equipment is in service.	This is an example of a technical requirement.
Content type		Shutdown loads shall include weight of equipment.	This is an example of a technical requirement.
Singular	Vent shall have a filter against airborne foreign matter and terminate in downward facing opening.	Vent shall have a filter against airborne foreign matter. Vent shall terminate in downward facing opening.	There are two requirements in the poorly written example.
Verifiable	Methods of calculation shall be defined at an early stage of the design.	Ability for compressor to be removed shall be confirmed by calculation.	In the poorly written example, "early stage" is not defined and "methods of calculation" is not a technical characteristic.
Verifiable	Use of guard elements to capture debris shall be considered.		"Shall be considered" is not verifiable.
Content type	For letdown stations incorporating power recovery turbines, a detailed engineering analysis shall be completed.	Letdown stations incorporating power recovery turbines shall be protected from overpressure.	In the poorly written example, the purpose of the analysis, in terms of a characteristic of the final product, is not defined.
Content type	Company and Company appointed representative shall have access to workshops and testing facilities.		Requirement should be in a contractual document rather than a technical specification.

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