NOT MEASUREMENT SENSITIVE

MIL-STD-337
24 July 1989

MILITARY STANDARD

DESIGN TO COST

AMSC A4756
AREA MISC

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FOREWARD

1. This military standard is approved for use by all departments and agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5270, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. In accordance with Department of Defense policy all relevant life cycle cost (LCC) elements shall be considered during selection and design of weapon systems. These costs include development costs, production costs, operation and support costs, and disposal costs.

4. Overall, Design to Cost (DTC) optimizes the use of the critical life cycle acquisition functions and data base management procedures, reports progress against cost targets, and takes appropriate action to achieve a realistic balance between cost targets and system performance requirements. This approach helps to assure that cost effective military systems are developed within the cost, performance, and time frameworks.

5. The crucial importance of DTC as a system parameter prompts a more aggressive approach to contracting for cost-effective products for purchase, operation, support and, in some cases, disposition. During the early phases of a weapon system's development, achieving a proper balance of cost, performance, readiness, supportability, and schedule in a changing world requires continual communication between the Government and the contractor. In some cases these program parameters will be in conflict and will require compromise. The Government program office is the proper and most knowledgeable authority for guiding these decisions since it is ultimately responsible for the final product. Consequently, during the course of a contract, particularly where cost is critical and the cost risk is high, provisions must be made to obtain guidance from the Government. This should be accomplished through appropriate contracting channels to update priorities and to clarify what is an acceptable mix of product characteristics.

6. Cost is a major consideration during the selection of subsystems and major components for the production end item. Note that the DTC process uses relevant LCC elements to the extent they discriminate between design choices. Later in the acquisition cycle, DTC is used as the means to compare current estimates against targets and to encourage cost reduction initiatives when a target breach appears imminent.

7. An issue which needs to be addressed is the conflict between cost-effective choices and affordable choices for design alternatives. The desire for cost-effectiveness may, at some point, be sacrificed to the practical considerations of the funding available to the Government program office. However, a prematurely imposed and unrealistic affordability requirement can needlessly preclude design choices that could have saved money and/or improved performance/effectiveness. The application of cost targets is, therefore, an important issue, requiring the contractor's technical expertise and the Government program office's knowledge of the total program issues to determine the proper timing and magnitude of cost targets.

8. Careful consideration and disposition of these cost issues is critical to an effective engineering cost control effort. Also, high quality cost analysis, concise and timely cost information, and rapid communication among the designers and decision-makers are the essential ingredients for successful DTC. Given proper guidance, information, and resources, the designers of military systems can better achieve cost-effective and affordable designs that can be economically produced and employed.

9. DTC is a concept of managing LCC elements. Properly implemented, this becomes a basic way of conducting defense business by making financial and system design decisions in terms of meeting requirements at the least total system cost. In most cases, a DTC program will not require new organizational entities to meet the requirements of this military standard. Critical functional areas (such as systems engineering, producibility, reliability, logistics, materials, quality and manufacturing engineering) are likely to be active in the design of military systems and will require only nominal additional effort to support cost tradeoff studies. DTC is mainly a matter of management direction of existing functions toward cost conscious design decisions, organizing existing data bases to support cost understanding by design decision-makers, reporting cost progress against cost goals, and taking appropriate action to achieve the latter. The level of effort for a DTC program should be commensurate with the risk involved in meeting the cost targets and the benefits derived. The effort should, therefore, be tailored accordingly.

CONTENTS

Paragraph		Page
1.	SCOPE.	1
1.1	Purpose.	1
1.2	Applicability.	1
1.3	Relation to other contract requirements. . . .	1
1.4	Tailoring.	1
1.5	Limitations.	1
2.	APPLICABLE DOCUMENTS	1
2.1	Government documents	1
2.1.1	Standards.	1
2.1.2	Other Government publication	2
2.2	Order of precedence.	2
3.	DEFINITIONS.	2
3.1	Acronyms used in this standard	2
3.2	Contract work breakdown structure.	3
3.3	Cost	3
3.4	Cost avoidance	3
3.5	Cost element structure	3
3.6	Cost drivers	3
3.7	Cost reduction	3
3.8	Design	3
3.9	Design to cost	3
3.10	Design to cost goal.	3
3.11	DTC targets.	4
3.12	Life cycle cost.	4
3.13	Procuring activity	4
4.	GENERAL REQUIREMENTS	4
4.1	DTC program.	4
4.1.1	Planning	5
4.1.2	Organization	5
4.2	Cost control	5
4.2.1	Cost drivers	5
4.2.1.1	High risk areas.	5
4.2.2	DTC targets.	5
4.2.3	Cost analysis.	5
4.2.3.1	Cost analysis documentation.	6
4.2.4	Variance analysis.	6
4.2.4.1	Variance analysis documentation.	6
4.3	DTC tradeoff studies	6
4.4	DTC preferred alternative.	6
4.4.1	Tradeoff studies documentation	6
4.5	Government access to data.	6
4.6	Government furnished information	7

CONTENTS - Continued.

		Page
5.	DETAILED REQUIREMENTS.	7
6.	NOTES.	7
6.1	Intended use	7
6.2	Issue of DODISS.	7
6.3	Data requirements.	7
6.4	Subject term (keyword) listing	7
APPENDIX	TAILORING GUIDANCE FOR PROCURING ACTIVITY. . . .	8

1. SCOPE

1.1 Purpose. This standard prescribes the Design to Cost (DTC) program objectives and requirements for design and development of military systems, subsystems, equipments, and software. Included are:

(a) Requirements for making Life Cycle Cost (LCC) elements inherent in the critical functional areas of reliability, logistics, and optimization by using tradeoff studies, cost estimation and tracking in the life cycle management acquisition process.

(b) Requirements for information sharing between Government and industry of data and studies relative to the acquisition and ownership costs of the weapon system.

(c) Requirements for relating DTC to the supportability considerations of the deployed system, to logistic support analyses, and to reliability and maintainability studies.

1.2 Applicability. This standard is applicable to contracts which involve engineering design and development of military systems, subsystems, equipment, and software. It is also to be used whenever major modifications and improvements to items currently in the inventory involve significant design activity.

1.3 Relationship to other contract requirements. This standard shall not detract from other contract requirements. If any inconsistency exists between the contract and this standard, the provisions of the contract shall govern.

1.4 Tailoring. Although the techniques presented in this standard are generally applicable to the design of all systems, subsystems, equipment, and software, the requirements should be tailored for each application. The degree/type of tailoring should reflect both the program phase (e.g., conceptual, demonstration/validation, full scale development, etc.) and the degree of risk.

1.5 Limitations. It is not the intent of this standard to prescribe or imply organizational structure or management methodology. This document does not cover the techniques of incentive contracting associated with monetary awards for achieving DTC targets. Also, it should not conflict with DTC implementation documents used by Department of Defense (DOD) components.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

STANDARD

MILITARY

MIL-STD-881 - Work Breakdown Structure for Defense Material Items

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DOD Instruction 5000.33 - Uniform Budget/Cost Terms and Definitions

(Copies of DOD Instruction 5000.33 are available from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Acronyms used in this standard. The acronyms used in this standard are defined as follows:

a. AMSDL - Acquisition Management systems and Data Requirements Control List.

b. CDRL - Contract Data Requirements List.

c. CES - Cost Element Structure.

d. CWBS - Contract Work Breakdown Structure.

e. DID - Data Item Description.

f. DoD - Department of Defense.

g. DODISS - Department of Defense Index of Specifications and Standards.

h. DTC - Design to Cost.

i. LCC - Life Cycle Cost.

j. TDP - Technical Data Package.

3.2 Contract Work Breakdown Structure (CWBS). The CWBS is a breakdown and identification, for a particular procurement, of all the acquisition tasks required during the development and production of a system or equipment. The CWBS closely follows the requirements of MIL-STD-881 and DoDI 5000.33 in identifying the hardware, services, and data required by a particular program or project throughout its planned life cycle.

3.3 Cost. Life cycle cost or a portion thereof.

3.4 Cost avoidance. Cost-effective design choices based on timely and concise cost information which result in avoidance of cost to the Government.

3.5 Cost Element Structure (CES). A breakdown of LCC elements that can be summarized under the major cost categories of Research and Development, Production (or Investment), and Operation and Support. A CES may differ in each phase of the life cycle.

3.6 Cost drivers. Those elements of cost which significantly impact the system/product LCC.

3.7 Cost reduction. A formal activity employed to rectify a cost target or sub-target breach. A cost reduction effort has a specific quantitative objective and may affect schedule, performance, or support to achieve the directed activity.

3.8 Design. The system design is an iterative process and becomes more detailed as the design cycle is accomplished. The final product is production ready documentation of all system elements which help determine the acquisition costs associated with LCC. These are the front end costs which combine with operation, support, and termination cost and represent the total system LCC. Design involves the progressive definition of specifications. Design involves selection of Technical Data Package (TDP), selection of production processes that will translate the TDP into deliverable hardware/software and the designation of a support concept which will provide for the operation and maintenance of the hardware and software throughout the total system life.

3.9 Design to cost. An acquisition management technique to achieve defense system designs that meet stated cost requirements. Cost is addressed on a continuing basis as part of a system's development and production process. The technique embodies early establishment of realistic but rigorous cost targets and a determined effort to achieve them.

3.10 Design to cost goal: A DTC goal is a firm cost or value that should be attained. A DTC goal differs from a DTC target in that the term goal is used in the DTC community when referring to Government in-house activities; the term target is used primarily in the DTC community to refer to contractual commitments between the Government and the contractor. These targets usually only contain elements that are under the direct control of the contractor.

3.11 DTC targets. Cost numbers, approved by the procuring activity, which the contractor translates into design requirements for the purpose of controlling and balancing production, logistics, operating, and support costs. These contractual targets are derived from Government DTC goals. These DTC goals are divided into smaller, identifiable tasks or areas of responsibility that serve as requirements for contractor or Government activities. Targets may be established for any relevant LCC elements/subelements, consistent with contractual ability to control/influence the element.

3.12 Life cycle cost. The total cost to the Government for a system over its full life, including the cost of development, procurement, operating and support, and where applicable, disposal.

3.13 Procuring activity. The Department of Defense component (the program/project office within the military department) responsible for contracting.

4. GENERAL REQUIREMENTS

4.1 DTC program. The contractor shall establish a DTC program to implement the requirements of this standard. The contractor shall institute procedures for managing and documenting the DTC program. As a minimum these procedures shall address program schedules, coordination, and scheduling of DTC tasks between the Government and contractor, identification of required input data, the applicable CES, and the CWBS. The DTC program shall be tailored to the specific weapons system with due consideration to risk and program phase. The contractor's DTC program shall encompass the following:

(a) planning, identifying cost drivers, developing cost targets, and conducting tradeoff studies to determine the most cost-effective alternatives. In response to cost objectives, the work breakdown structure principles shall be identified for collection and establishment of DTC targets;

(b) describing how DTC is accomplished in relation to management structure, processes, procedures, and contract schedules;

(c) monitoring cost targets, documenting progress, developing actions plans, and resolving problems;

(d) implementing feedback techniques, during the design process, to control relevant LCC;

(e) employing existing cost analysis methodologies and data sources, and providing justification for developing new methodology and data sources when necessary;

(f) reviewing DTC status and future plans in all design and program reviews; and

(g) documenting ground rules, assumptions, and methodology used in estimating DTC targets, estimates, and LCC.

4.1.1 Planning. The contractor shall develop a comprehensive plan implementing the DTC program and address the DTC effort for each acquisition phase (see section 6).

4.1.2 Organization. The contractor shall use the existing organization to structure a DTC effort. This includes the management structure and accountabilities, policies and procedures, and functional relationships for making cost a key decision and design parameter. Unique DTC organizational elements shall be justified in the DTC plan.

4.2 Cost control. The contractor shall plan and execute an effective engineering-oriented cost control strategy which focuses on the cost of production and the cost of operation and support. The objective of this effort shall be to achieve an affordable product which is acceptable in terms of performance, readiness, effectiveness, supportability, and schedule.

4.2.1 Cost drivers. The contractor shall identify major cost drivers, maintain a prioritized list of the drivers, and undertake to develop the least expensive alternative that meets minimum performance and schedule requirements. A list of major cost drivers shall be prepared early in the contract. These cost drivers shall receive the greatest emphasis in controlling costs. The list of cost drivers shall account for approximately 80 percent of the cost.

4.2.1.1 High risk areas. The contractor shall identify potential problem areas in the cost estimating methodology or in the reliability of the cost forecasts due to program uncertainties and shall reduce the risks in these areas to an acceptable level. Examples of the areas that should be considered for their contribution to cost risk are: (1) schedules, (2) quantities, (3) design changes necessitated by high cost or excessive component failure, (4) test schedules, number of tests, duration of tests and results, (5) improvement (learning) curve assumptions, (6) historical information and cost data, (7) inadequate tailoring of specifications and standards, (8) excessive support cost due to inadequate attention to levels of maintenance, maintenance philosophy, manpower requirements, availability predictions or supply planning, (9) new technology, and (10) increased mission capability.

4.2.2 DTC targets. The contractor shall continuously analyze cost forecasts and take appropriate action whenever a target breach is indicated or forecast. In the event of a probable target breach, the contractor shall assess contributing factors and identify courses of action, including a zero growth alternative. The contractor shall document and communicate probable target breach and a corrective action plan to management, design personnel, and the Government, specifying action(s) required to resolve the problem(s).

4.2.3 Cost analysis. The contractor shall perform cost analysis employing cost methodology compatible with DTC program objectives. To the extent that the contractor's data base is insufficient for the DTC effort, the contractor shall request access to Government data from relevant activities such as: (1) reliability and maintainability, (2) integrated logistics support, (3) logistics support analysis, (4) repair level analysis, and (5) maintenance

engineering analysis. Subject to Government review and coordination, the contractor shall propose the most suitable estimating methodologies, ground rules and assumptions, data sources, performance/cost models, and equations to be used in documenting the LCC estimate.

4.2.3.1 Cost analysis documentation. The contractor shall document the ground rules, assumptions, and methodology used to produce each, cost target, and cost estimate.

4.2.4 Variance analysis. The contractor shall track changes from baseline estimates. Categories of changes include, but are not limited to, changes in program due to design, quantity changes, and schedule updates. Each change shall identify specifically what has changed since the last report and why. The cost impact of each change will be discussed in the report.

4.2.4.1 Variance analysis documentation. The contractor shall document the ground rules, assumptions, and methodology used to estimate the cost impact for each change.

4.3 DTC tradeoff studies. In addition to the tradeoff studies directed by the Government program office, the contractor shall select the necessary tradeoff studies to be conducted to determine which alternatives provide the best combination of cost, performance, and supportability within the time constraints imposed by acquisition and deployment schedules. Tradeoff study candidates shall be selected from the list of cost drivers. DTC tradeoff studies shall consider development and maintenance costs of software (i.e., built-in diagnostic capability, external automatic test equipment, maintenance philosophy and reliability, maintainability, and availability factors) with the objective of reducing and controlling these costs. DTC tradeoff studies shall provide information for the decision-making process regarding cost targets, performance, and cost effectiveness. DTC tradeoff studies shall use existing current data and shall not duplicate similar efforts conducted under the same contract. DTC tradeoff studies shall result in the identification of preferred alternatives. The results of these tradeoff studies shall be fed back promptly to decision-makers and designers responsible for cost reduction and cost avoidance activities.

4.4 DTC preferred alternative. For all tradeoff studies, the contractor shall develop a method for identifying which alternative is preferred from a DTC point-of-view. This procedure shall include the consideration of potential conflicts arising from the issues of cost targets versus performance, cost targets versus supportability, cost targets versus schedule, and cost targets versus LCC effectiveness.

4.4.1 Tradeoff studies documentation. The contractor shall document the ground rules, assumptions, and methodology used to estimate all alternatives.

4.5 Government access to data. The contractor shall provide Government access to contractor technical personnel, cost methodology, and related data bases to support monitoring, surveillance, and verification efforts.

4.6 Government furnished information. The contractor shall be responsible for identifying and requesting the needed information from the procuring activity, as necessary to comply with the terms of the contract.

5. DETAILED REQUIREMENTS

This section not applicable to this standard.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard is intended for application to all systems, subsystems, equipments, and software which involve substantial engineering development and design. It provides general and specific requirements to ensure effective control of the design-related production and ownership costs. This is accomplished by a DTC program which is planned, documented, implemented, and reviewed in consonance with related technical and management disciplines.

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1).

6.3 Data requirements. The following Data Item Descriptions (DID's) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this standard is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for DD Form 1423.

Paragraph No.	DID Number	Data Requirement Title	Suggested Tailoring
4.1	DI-MISC-80856	Design to Cost Plan	-
4.2, 4.3, 4.4	DI-MISC-80857	Design to Cost Status Report	-

The above DID's were those cleared as of the date of this standard. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Subject term (keyword) listing.

Design to cost
Life cycle cost

APPENDIX

TAILORING GUIDANCE FOR PROCURING ACTIVITY

10. GENERAL

10.1 Scope. This appendix provides the Government acquisition office or procuring activity with general information on applying this Military Standard, as tailored, to contracts with varying DTC requirements so as to assure that the contractor's DTC program adequately addresses the problem of controlling design induced costs as well as providing information to support the government's in-house DTC effort.

20. APPLICABLE DOCUMENTS. This section is not applicable to this appendix.

30. DEFINITIONS. This section is not applicable to this appendix.

40. GENERAL INSTRUCTIONS

40.1 Acquisition strategy and cost control. There are many acquisition techniques used to control procurement costs. Competition and fixed-price contracts are examples. Such techniques concentrate on controlling the cost in the present acquisition situation, be it development or production. DTC, on the other hand is concerned with the future costs of production, operation, and support. The structure of a contractor's DTC program should be guided by the nature of the product being designed rather than by the character of the instant contract. Therefore, when implementing DTC on any given contract, one must look ahead and assess the risks involved in manufacturing, operating, and supporting the proposed design. When these risks are high, as in development efforts relying on advanced technology or novel support concepts, the DTC program should aggressively work to solve cost problems as they emerge, should make a strong effort to reduce cost estimating uncertainty, and should promote a cost-conscious working environment where less costly alternatives are given visibility and consideration. In lower risk situations, the DTC program may be less active. This type of DTC effort deals mainly with providing cost visibility and cost status reporting, unless cost problems arise. An impending target breach in this situation should cause the lower risk DTC effort to become more active by taking appropriate measures against the adverse trend.

40.1.1 Government DTC effort. Although the Government does not usually design or manufacture the product, it establishes the requirements and continually makes decisions which affect the design process. The contracting agency shall implement a strong internal cost consciousness and communicate the importance of cost to the contractor(s). A minimal in-house DTC effort is, therefore, necessary to disseminate the contractor's Contract Data Requirements List (CDRL) information among the appropriate decision-making levels in the Government. In a high risk situation, the Government's role may be expanded to include active involvement of Government engineers and decision-makers working with their contractor counterparts to solve day-to-day cost problems. The CDRL

information, in such a case, should be detailed, concise, and timely enough to support this type of effort. When the contractor finishes the design and the program transitions to production, the Government must then take measures to control cost growth induced by engineering change proposals.

40.1.2 Contractor DTC effort. The chief burden of performing DTC falls on the contractor designing or manufacturing the product. An essential part of a contractor's DTC program is to provide accurate, concise, and timely cost estimates and DTC status information to the appropriate contractor and Government decision-makers. The degree of involvement and depth of reporting depends on the risk. Low risk programs may involve only the higher levels of the organization. High risk programs may include all levels with cost requirements levied on the individual designers.

40.2 Establishing contractual targets. A premature cost target invites improper design choices. If the target is too low, unnecessary reductions in performance could occur. If the target is too high, lower cost alternatives may be disregarded. However, DTC is most effective when applied early in the acquisition cycle. The sooner the designers know their cost requirements, the easier it is to prepare a design which accommodates those requirements. In some acquisition programs there is a good, early understanding of what the future costs of production and ownership should be. In such a case, cost targets should be established contractually as early as possible. On the other hand, in high risk situations, the estimates of future costs can be highly uncertain. Under these circumstances cost targets should be developed carefully, step by step. For example, in the conceptual phase of the acquisition process, the Government may not know what the cost target should be for a certain high technology weapon system. Design emphasis during this phase should be on LCC effectiveness. Later, perhaps in the validation phase, these future costs may be better understood through more accurate cost estimates based on a more detailed design. This could then be conveyed to the contractor via the statement of work as a rough idea of what the Government thinks these costs should be. This number or range (not a target) should have the effect of guiding rather than forcing the design. By full-scale development, the contractor and Government, through intensive cost estimating and analysis, should be in a position to negotiate a realistic cost target. As a rule of thumb, the designers should be given their cost requirements concurrently with performance requirements (e.g., weight, speed, reliability, etc.). Another consideration in establishing cost targets concerns contracts that try to limit production cost. When full-scale development or production contracts are written with "not to exceed" or "fixed price" conditions on production lots, one can increase the visibility and importance of the production cost target by relating it to these option prices as well as to the average unit cost of the total planned buy.

40.3 Tradeoff studies. Ensuring cost visibility in the design tradeoff process is an essential function of DTC. Ideally, the normal tradeoff process will address all major cost drivers. However, in those instances where coverage is incomplete, the contractor should address the omitted cost drivers via the DTC tradeoff studies. These tradeoff studies should be conducted and reported under the Data Item Description for tradeoff studies currently in the instant contract.

CONCLUDING MATERIAL

Custodian:
Army-MI
Navy-AS
Air Force-11

Reviewers:
Army-AR, EA
Navy-AS, EC
Air Force-14, 15, 18
DLA-GS

Preparing Activity:
Army-MI

Project MISC-0084

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-337	Design to Cost

a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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