A GLOVEBOX DESIGN CHECKLIST

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ABSTRACT

A glovebox design checklist has been developed at Argonne National Laboratory. It provides engineers with a list of items that should be considered when designing a glovebox. Major elements included in the checklist are the glovebox shell, appurtenances, glovebox supports and stands, special shielding, instrumentation, fire protection, windows, atmosphere, human factors, material handling, vessels, furnaces, electrical needs, cooling and heating, piping, testing, installation, safety, decommissioning, and quality assurance.

INTRODUCTION

The design of a glovebox is a process that requires planning early in the design cycle to ensure that all requirements are clearly established. The omission or misunderstanding of one or more of these requirements could lead to cost- and schedule-affecting impacts during the manufacturing, installation, and/or operational phases of the glovebox[1]. Implementation of certain quality techniques can help an engineering team to logically consider the many issues that need to be addressed at each stage of the glovebox design. These techniques include use of design standards manuals, utilization of tools for analysis, review of earlier designs, design reviews, design verifications, and use of design checklists. This paper addresses the last of these techniques, i.e., use of design checklists.

Design checklists list all items and features that should be considered by engineers who are designing a particular piece of equipment. Checklists tend to be evolving documents. They provide a way to concisely capture expertise in a form that will be useful for detecting errors of omission early in the design process. Checklists

are compiled on the basis of common guidelines for the particular type of equipment (e.g., a glovebox), and from experience. Thus, as more experience is gained and new information is received, a particular checklist can change.

The use of design checklists is considered by experts in the quality-assurance field to be a "best current practice"[2]. The term "best current practice" means that a particular methodology (e.g., the use of a design checklist) has been an important part of the design processes of successful companies, organizations, etc.

GLOVEBOX DESIGN CHECKLIST

A copy of the Glovebox Design Checklist developed at Argonne National Laboratory (ANL) is attached to the end of this paper. It is based primarily on the technical information provided in Reference 3 and experience at ANL. Major glovebox design items and issues included in the checklist are:

- Glovebox shell (including material, finishes, and linings)
- Appurtenances
- Supports/stands
- Special shielding requirements
- Instrumentation
- Fire protection
- Windows
- Glovebox atmosphere (including purification systems)
- Human factors (including lighting, alarms, displays, and maintainability)
- Material handling in and near the glovebox
- Vessels that will be needed in the glovebox
- Furnaces
- Electrical needs

- Cooling and/or heating within the glovebox
- Piping to, from, and in the glovebox
- Testing of the glovebox and related components
- Installation
- Decommissioning
- Safety considerations
- Quality assurance

The checklist includes several header lines for project, staffing, and schedule information. The main body of the checklist includes three columns. The first lists the particular design item or issue for consideration. The second column is used to indicate whether the item or issue must be addressed when detailed specifications are developed for a new or refurbished glovebox. The third column provides space for some initial brief notes concerning the particular item or issue. At the bottom of the table, there is some additional space for listing other requirements, considerations, etc., that may not have been addressed in the main body of the checklist.

After completing the checklist, the design team can begin to develop detailed specifications. Project managers can also use the checklist to help determine the scope of the job and, hence, establish staffing requirements and schedules. In addition, design reviewers can use the checklist as an inspection tool. Thus, it is clear that use of the Glovebox Design Checklist should not be limited to only one time in a project. Changing requirements or new information could necessitate adjustments in the design. Hence, it is suggested that the checklist be utilized several times during the design process, particularly when interfaces among various glovebox components are being established and when design information is released prior to fabrication.

BENEFITS

Both qualitative and quantitative benefits result from the use of the Glovebox Design Checklist. These include[2]:

- The establishment of requirements agreements between the customer and the design team early in the design cycle
- The prevention of omissions and common design mistakes
- The early identification of potential problems and errors

- The ability to do the job correctly the first time
- A better consistency in glovebox designs and related documentation
- The sharing of glovebox design expertise
- The smooth flow of design knowledge from earlier to later glovebox projects
- An increased awareness of effective practices, standards, etc., especially for people new to glovebox design
- Added information for design-review packages
- Higher productivity during design-inspection meetings
- Better product knowledge
- The development of realistic schedules
- More accuracy in determining staffing requirements
- The promotion of teamwork
- A focus on glovebox quality

It is important, however, to realize that the checklist should be used together with the other quality techniques mentioned in the Introduction, other good design practices, product knowledge, and other key design elements, to ensure the design of a quality glovebox that meets the needs of the users.

CONCLUSION

The use of the Glovebox Design Checklist has enhanced the glovebox design process at Argonne National Laboratory. Similar types of checklists have been developed and used by other industries. Some key indicators that a project would benefit from use of the Glovebox Design Checklist are:

- The project is large and complex
- The project schedules and budget will be closely scrutinized
- Earlier, similar projects were plagued with design changes and rework

- The design and/or fabrication team's overall experience of glovebox design is somewhat limited

Even if none of the above indicators is present, the use of the checklist is still encouraged. When the use of checklists becomes an integral part of the design process, fewer errors and omissions will occur.

The author encourages feedback on the Glovebox Design Checklist. If additional items should be added, or if clarification is needed, please contact him.

ACKNOWLEDGMENTS

I would like to thank the members of the American Glovebox Society Standards Development Committee, who wrote, edited, and produced the *Guideline for Gloveboxes*[3]. The Glovebox Design Checklist is based primarily on this document. I also acknowledge R. F. Malecha of ANL for providing input and review comments based on his more than 40 years of experience in the glovebox-design field. Finally, I thank M. A. Slawecki, R. L. Tollner, and S. G. Wiedmeyer for reviewing the checklist and providing feedback.

REFERENCES

1. A. A. Frigo, R. F. Malecha, and E. F. Lewandowski, "The Use of Design-for-Manufacturability Techniques to Ensure the Quality of Large Gloveboxes", in *Proceedings of the Seventh Annual Conference and Equipment Display of the American Glovebox Society, August 16-19, 1993*, Seattle, Washington, p. 40 (1994).

2. *Hardware Design Checklists*, edited and produced by AT&T Bell Laboratories, AT&T's Customer Information Center, Indianapolis, Indiana (1990)

3. *Guideline for Gloveboxes*, AGS-G001-1994, edited and produced by the American Glovebox Society Standards Development Committee, American Glovebox Society, Santa Rosa, California (1994)

GLOVEBOX DESIGN CHECKLIST

Description/Location: Design Task Number:

Customer: Date:

Design Engineers / Designers: _____

Required Operational Date: _____

Design Area	Consider (✓)	Requirements/Comments
Shell		
New		
Old		
Material		
Finish/Lining		
Other		
Appurtenances		
Gloveports		
Gloves		
Bagports		
Transfer Locks		
Filters		
Penetrations		
Other		
Supports/Stands		
Anchoring		
Bracing		
Other		
Special Shielding		
Walls		
Floor		
Ceiling		
Windows		
Other		

Design Area	Consider (✓)	Requirements/Comments
Instrumentation		
Routing		
Feedthroughs		
Shielding		
Monitoring		
Gas Analyzers		
Radiation		
Pressure Controls		
Other		
Fire Protection		
Inside		
Outside		
Windows		
Material		
Gasketing		
Mounting		
Other		
Atmosphere		
Once-through		
Recirculation		
Special Gas		
Purification		
Pressure		
Temperature		
Other		
Human Factors		
Illumination		
Alarms		
Controls/Displays		
Maintainability		
Other		

Design Area	Consider (✓)	Requirements/Comments
Material Handling		
Cranes/Hoists		
Conveyors		
Processors		
Samplers		
Other		
Vessels		
Wells		
Covers		
Special Pressure		
Heating/Cooling		
Other		
Furnaces		
Internal		
External		
Electrical		
Power		
Control		
Routing		
Feedthroughs		
Shielding		
Motors/Drives		
Induction Leads		
Limit Switches		
Instrumentation		
Other		
Cooling/Heating		
Load		
Equipment		
Ducting		
Other		

Design Area	Consider (✓)	Requirements/Comments
Piping		
Routing		
Feedthroughs		
Fittings		
Materials		
Gases		
Liquids		
Cooling/Heating		
Vacuum		
Special Valves		
Other		
Testing		
Leak/Method		
Other		
Installation		
Space Required		
Utilities		
Special Issues		
Decommissioning		
Special Issues		
Safety		
Filters		
Pressure Relief		
Other		
Quality Assurance		

Other Requirements, Considerations, etc.: