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ANALYSIS OF DEFECTS IN TROUSER MANUFACTURING: DEVELOPMENT OF A KNOWLEDGE-BASED FRAMEWORK

Volume III: SDAS User Manual

Research sponsored by

Defense Logistics Agency
DLA-PRM
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Alexandria, Virginia

DLA Contract #: DLA-900-87-D-0018-0003

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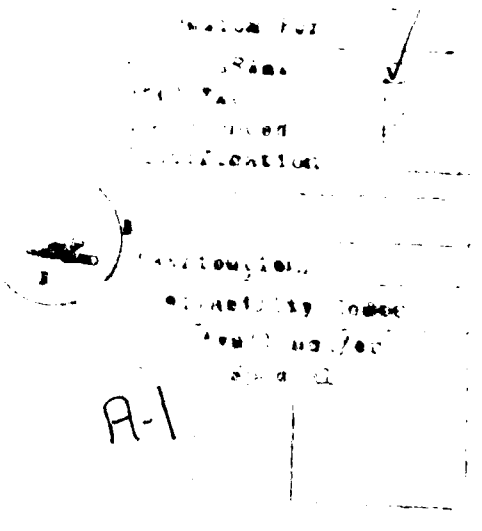

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EXECUTIVE SUMMARY

Research has been carried out to analyze defects in apparel manufacturing. Two knowledge-based software systems -- FDAS (Fabric Defects Analysis System) and SDAS (Sewing Defects Analysis System) -- have been developed. The research has been funded by the U.S. Defense Logistics Agency under contract number DLA-900-87-D-0018-0003.

FDAS covers the common manufacturing defects occurring in greige and finished fabrics, including those in indigo-dyed denims. SDAS covers the defects occurring in the cutting, sewing, finishing and packing departments of an apparel plant producing denim trousers. Based on the visual description of the defect in the fabric (type, orientation and mode of repetition of the defect), FDAS identifies the defect and suggests possible causes and remedies.

SDAS uses information on the location and nature of the defect to identify the manufacturing operation causing the defect and displays possible causes and remedies for the defect. SDAS also has a provision to display the relevant construction specifications (MIL-SPEC) for the assembly operation causing the defect. Both FDAS and SDAS are implemented in Nexpert Object and are linked to a relational data base using Oracle. They run under both MS-DOS and Unix environments. Software manuals for using FDAS and SDAS have been produced.

FDAS is intended for use at the greige or finished fabric inspection station in a weaving plant. It can also serve as a backend to a vision-based inspection system. SDAS can be used by an apparel plant for the inspection of trousers.

About the Report: The final technical report is presented in three volumes. In Volume I, the details of the research effort are discussed along with recommendations for additional research. Volume II is the software user manual for FDAS, while Volume III (the present volume) is the software user manual for SDAS.

1. INTRODUCTION

1.1 What is SDAS?

SDAS (Sewing Defects Analysis System) is an identification and diagnosis system for defects encountered in the manufacturing of military utility trousers as described in MIL-STD-87062. The system covers the common defects occurring during garment manufacturing operations such as cutting, sewing and finishing. The development of the system has been funded by the U.S. Defense Logistics Agency.

1.2 Working Principle of SDAS

The flowchart in Figure 1 summarizes the working of SDAS.

First, the user indicates the **defect location** (waistband, pocket, etc.) and the **defect type** (open seam, broken thread, etc.). After receiving this information, SDAS attempts to find what manufacturing process could have caused the defect. If the existing information is not sufficient to do this, it seeks more specific information regarding the location of the defect (right end of the waistband, pocket edge, etc.) and the nature of the defect (badly formed or badly placed belt-loops, etc.). Once SDAS is able to find the manufacturing operation causing the defect, it displays possible causes and suggested remedies to the user. The system also records the information regarding the defect location, type and manufacturing operation causing the defect in a database. Along with this diagnosis process, the system compiles a list of all the utility trouser construction specifications (MIL-87062) relevant to the defect described by the user and displays it if the user so desires.

1.3 Scope and Applications of SDAS

SDAS is tailored for analysis of defects occurring in military utility trousers. Its working principle can be used for building similar systems for other types of garments as well. However, this will require additional effort in knowledge acquisition, testing, etc., as the manufacturing process sequences differ widely for different garment types.

Classification and analysis of defect occurrences on a day-to-day basis will be helpful in maximizing the percentage of first quality production. The link to a database enables SDAS to be used for the analysis and control of defects. It is particularly useful to keep track of defect occurrences over short and long-term intervals and to initiate remedial action when required. Database software will also simplify report generation and quality monitoring.

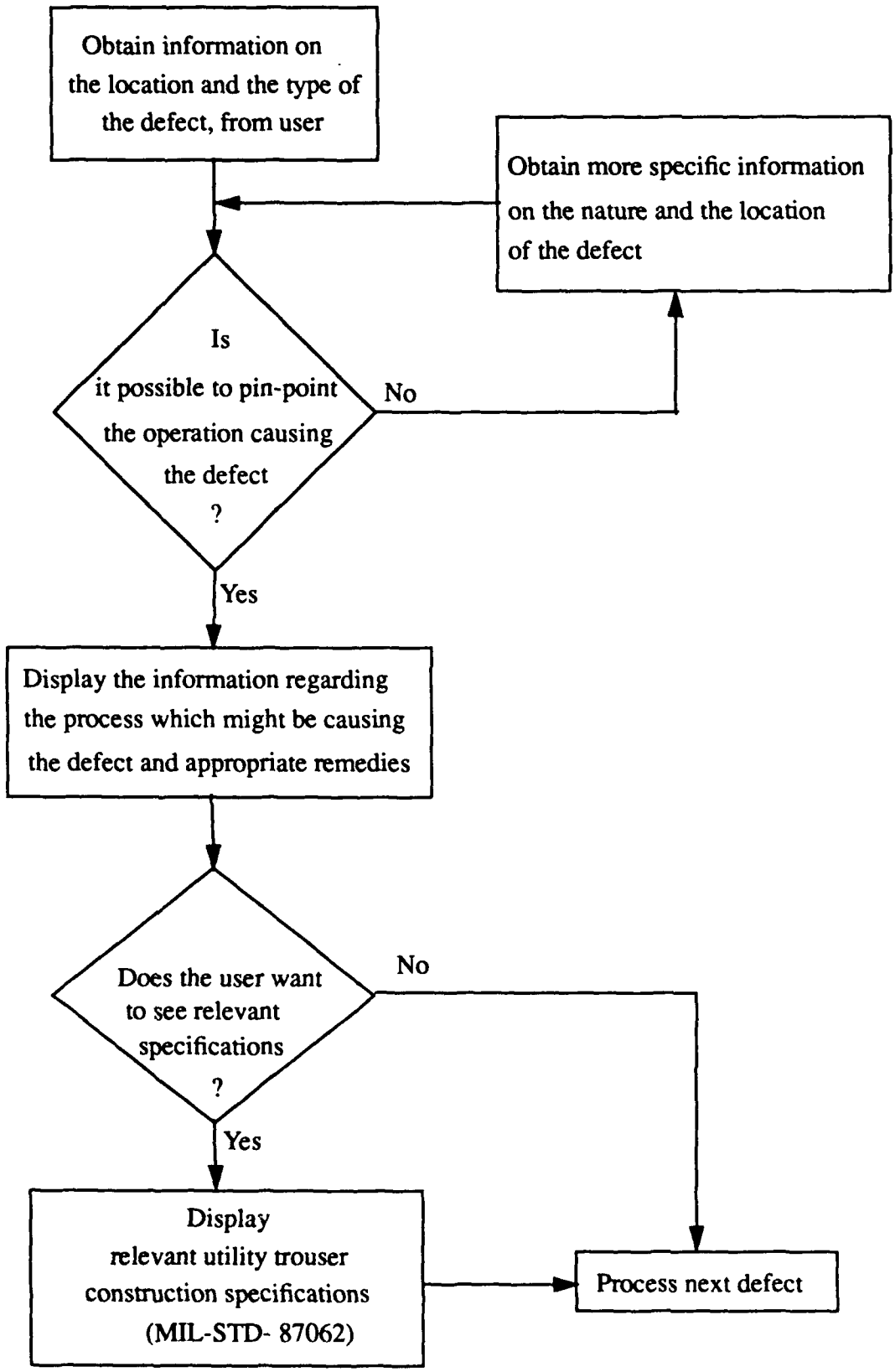

Figure 1. Flowchart for the Analysis of a Single Defect

1.4 Requirements From the User

To make efficient use of SDAS, the user should possess a basic understanding of the system. It is very important to remember that the SDAS is an aid for the classification and analysis of garment defects and not a replacement for a sharp-eyed and experienced inspector.

The learning time depends on the background and education level of the user but is not expected to be more than a day or two at most. An average high school graduate with basic analytical skills and an adequate exposure to the production environment can understand and operate the system.

The software is user-friendly and is designed to work fast. The design of the system is such that the user spends very little time on the computer and more time on garment inspection. Classification and analysis of a single defect will take 10-20 seconds, depending on the type of defect being analyzed, and how quickly the user responds to the queries posed by the system.

2. OPERATIONAL DESCRIPTION

The operation of the system involves three major steps:

1) Obtaining information about the defect from the user.

2) Establishing the specific manufacturing process responsible for the particular defect under review and simultaneously compiling the list of relevant MIL-STD-87062 specifications, based on information provided by the user.

3) Presenting the probable causes and suggested remedies (and also the specifications list, if desired) to the user, and writing the information to a database.

If the user makes a mistake while providing the set of visual characteristics of a defect, the software allows the user to re-start the analysis from the beginning. In fact, at any point during a session, the user is free to abort it and start a fresh one using the F1 key.

2.1 Starting Up SDAS

The current version of SDAS records defect data to an Oracle® database. Along with SDAS software, a database file is also provided. Ensure that Oracle is running before starting up SDAS.

Go to the directory "\nexpert\sewdef." Start the defects analysis software by typing "sdas" at the command prompt. SDAS automatically loads the sewing defects knowledge base.

2.2 Defect Analysis

The system depends solely on the user's input to correctly identify any particular defect in a garment. The importance of correct input to the system, based on the actual appearance of the defect, therefore, cannot be over-emphasized. SDAS seeks and receives information in a step-by-step manner and, at each step, it makes certain decisions based on the current information. At any of the input stages, if the user fails to respond to SDAS's query, no further progress is possible. However, the user can choose to abort the current analysis and start all over again by using the F1 key. The cycles of defect analysis and diagnosis are continuous and automatic, until the user decides to quit SDAS (using the F2 key).

2.2.1 Input of defect location

As soon as defect analysis is initiated, the system brings up a question (see Figure 2), asking for the defect location.

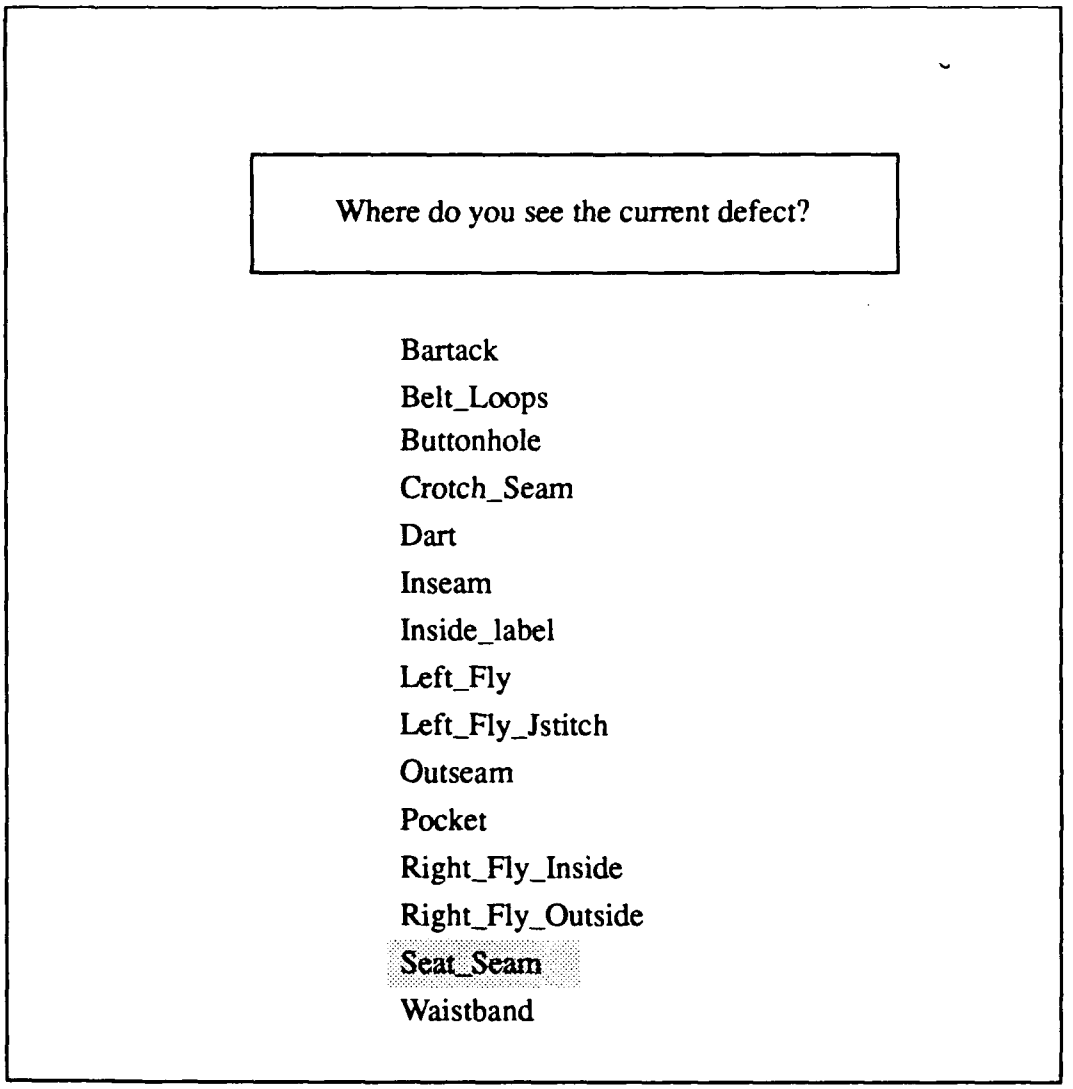

Figure 2. Defect Location Selection Screen

Let us assume the user selects Seat Seam as the location where the defect is observed.

2.2.2 Input of defect type

After the user indicates the defect location, the software displays a query as shown in Figure 3 and seeks information on the defect type.

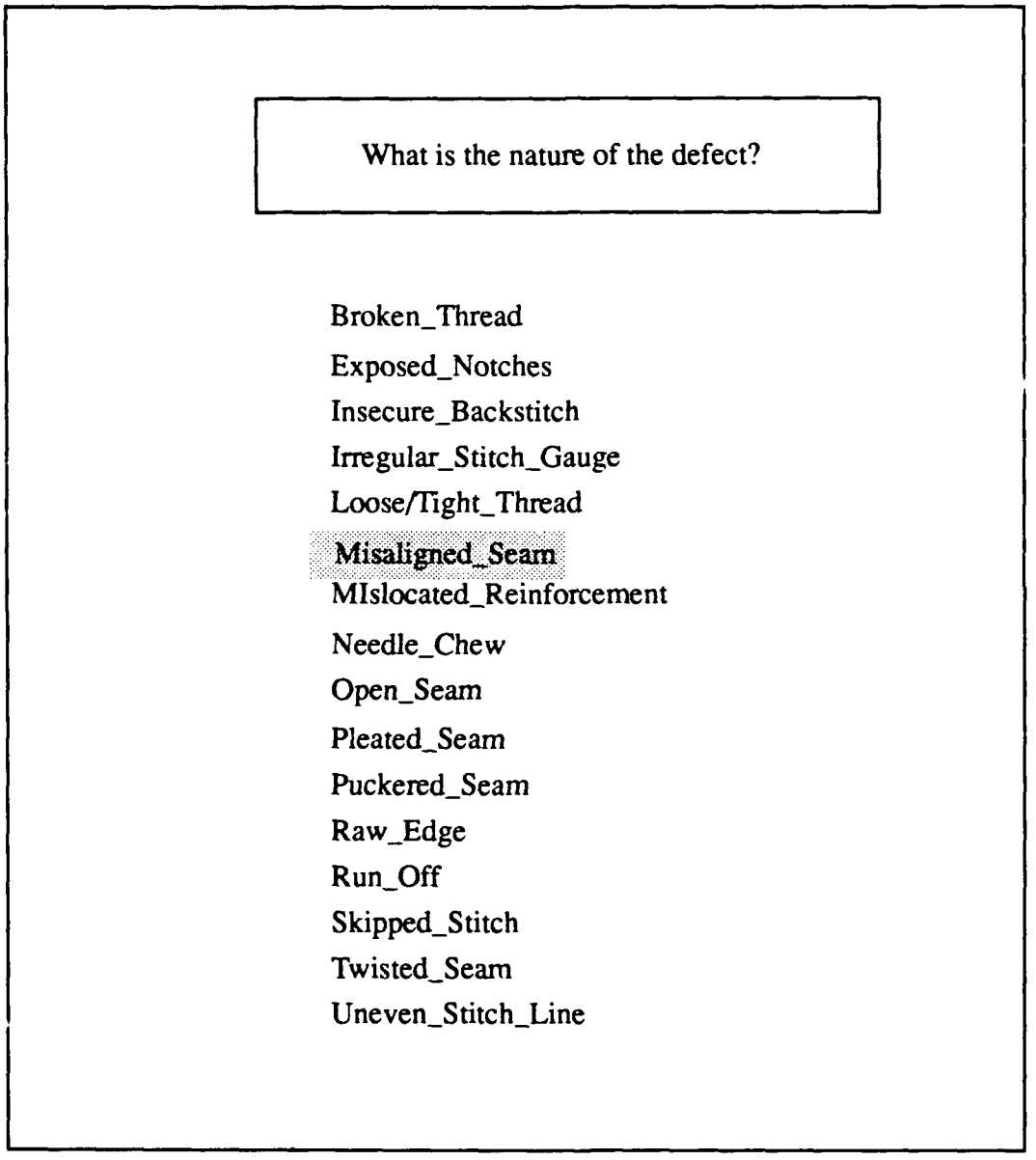

Figure 3. Screen for the Indication of Defect Type

Let us assume the user selects Misaligned Seam as the type of the observed defect.

2.2.3 Diagnostics from SDAS

In this case, the system needs no further information to establish the manufacturing process causing the defect. It displays a screen containing information about the probable causes and remedies for the defect described by the user (Figure 4). This information is also written to a database.

Checkpoints for Misaligned Seam:

1. A bent needle can cause the stitch line to deviate during stitching, and result in a misaligned seam or even a run-off.

2. On a completely manual machine, this defect can be the result of the operator lining up the feed into the sewing head in a wrong position from the very start.

3. If a folder is being used, it must be of a suitable type and must be set correctly to give the required seam margins relative to the sewing head. The operator must not hold back on the fabric plies as they are run through the folder.

4. Too high a setting for the feed dog will cause backfeed of the lower ply as the feed dog performs its return traverse. This will result in a skewing of the two fabric plies going into the seam, and variation in seam margin.

5. The same differential feed problem will be observed if the pressure exerted by the presser foot is too high; in this case, it will be the top ply being held back from its usual feed rate.

Specific Checkpoints for Misaligned Seams at the Join Seat Seam Operation:

1. Operator error is likely to be the main cause for a Misaligned seat seam, in lining up the edges of the two plies perfectly for feed into the folder, and maintaining this same alignment during the stitch run.

2. If the operator has a practice of overfeeding material into the folder, the extra fabric is absorbed into the margin rather than into the felled seam.

F1 Next Session

F2 Exit FDAS

Figure 4. Diagnostics from SDAS

2.2.4 MIL 87062 Specifications

SDAS first asks the user if the specifications are to be displayed (Figure 5). If the user de-

sires to see the specifications, they are displayed as shown in Figure 6.

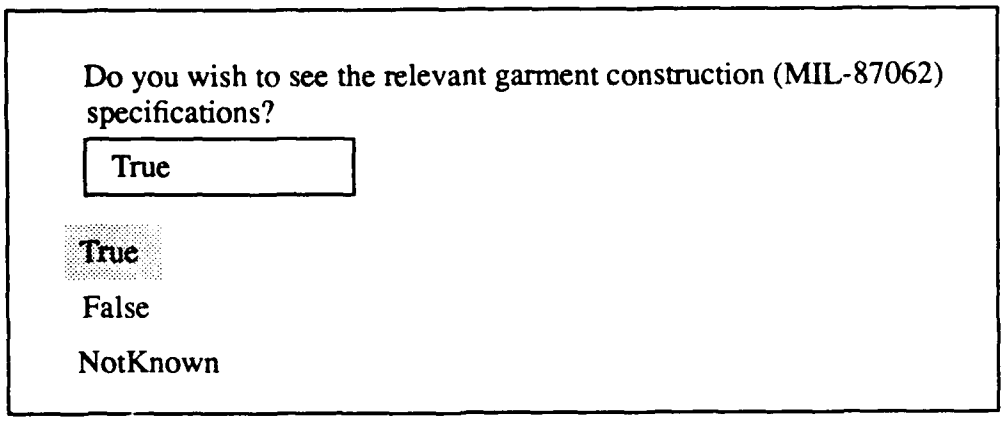

Figure 5. Option for User to see MIL-87062 Specifications

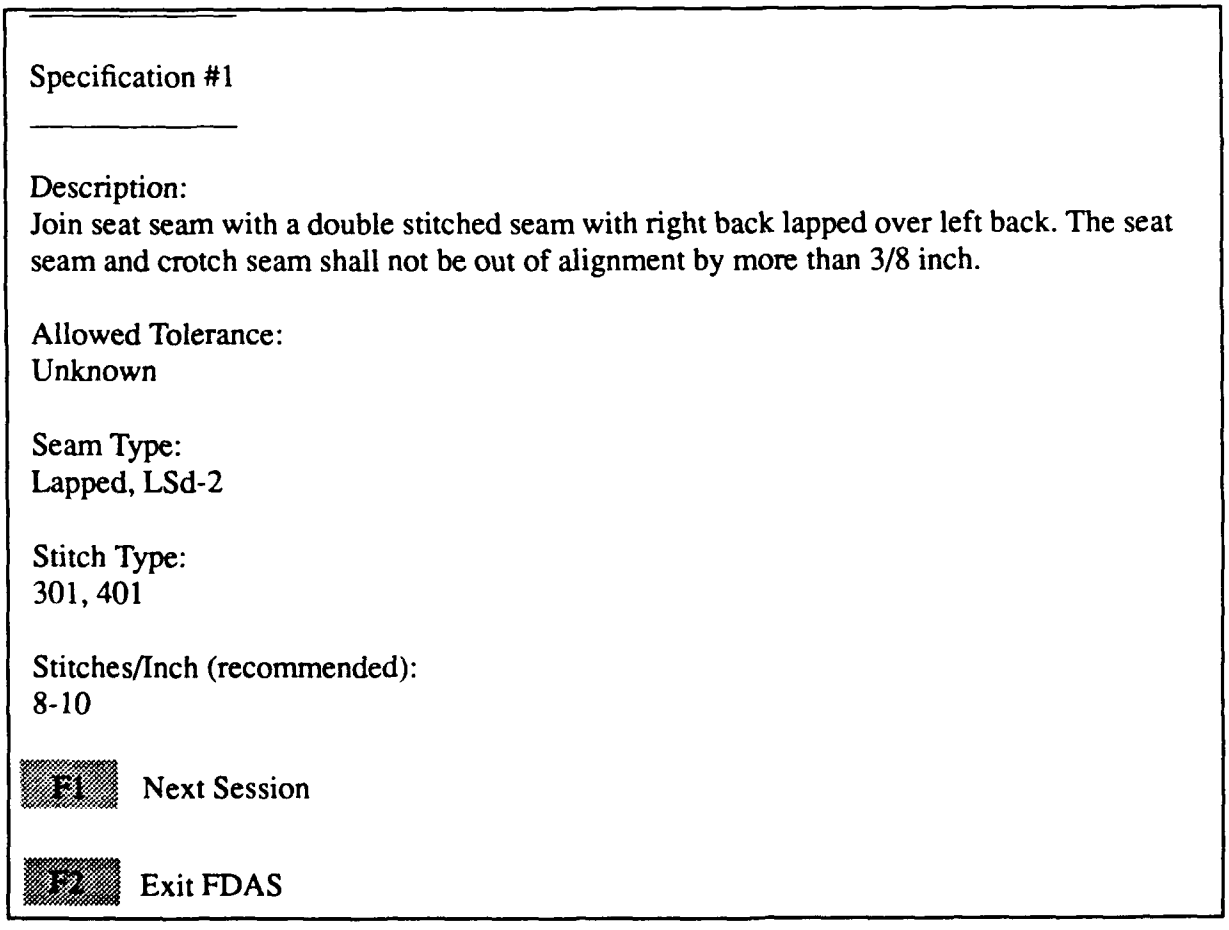

Figure 6. Relevant Garment Construction Specifications (MIL-87062)

2.3 Diagnosis Capability of the System

The diagnosis information for the defects is available in the "causes" subdirectory on the computer. These files are highly modular, i.e., information in these files is very specific to defects of particular types, and at particular locations. As SDAS obtains information from the user, it compiles information from these files according to the information provided. This dynamic compilation of the diagnostics files to be displayed to the user ensures that all information relevant to the defect described by the user is displayed. For example, Figure 4 contains information in general about Misaligned Seam (defect type specified by the user) and also information specific to Seat Seam (defect location specified by the user).

These diagnosis files may be accessed and modified to suit the needs of individual process conditions and manufacturing technologies. The changes to the diagnosis files can be made with the help of a text editor. SDAS can thus be customized to meet special demands and needs.

The other output from the system, the construction specifications (MIL-87062), is also very specific to the defect described by the user.

3. SAMPLE SESSION

The previous section explained the working of SDAS, using the example of a misaligned seat seam. In this section another example (needle chew on the pocket) is provided. In this case, SDAS will not be able to establish the cause of the defect directly from defect location and type as in the previous case, and hence will seek more specific information from the user.

The user inputs for the defect location and type are shown in Figures 7 and 8. A defect fitting this description could have been caused by one of the several manufacturing operations such as, making of the patch-pocket, positioning it, or hemming it. To identify the culprit process exactly, SDAS goes on to ask more specific questions about the nature of the defect. It will first ask if the defect is due to the way the pocket has been hemmed (Figure 9). Assume the user selects "False" in response to this query. SDAS goes on to ask if the defect is due to bad positioning or stitching (Figure 10). If the user's answer is in the affirmative, SDAS displays the diagnosis (Figure 11), writes to the database and displays the relevant specifications in case the user wishes to see them (Figure 12).

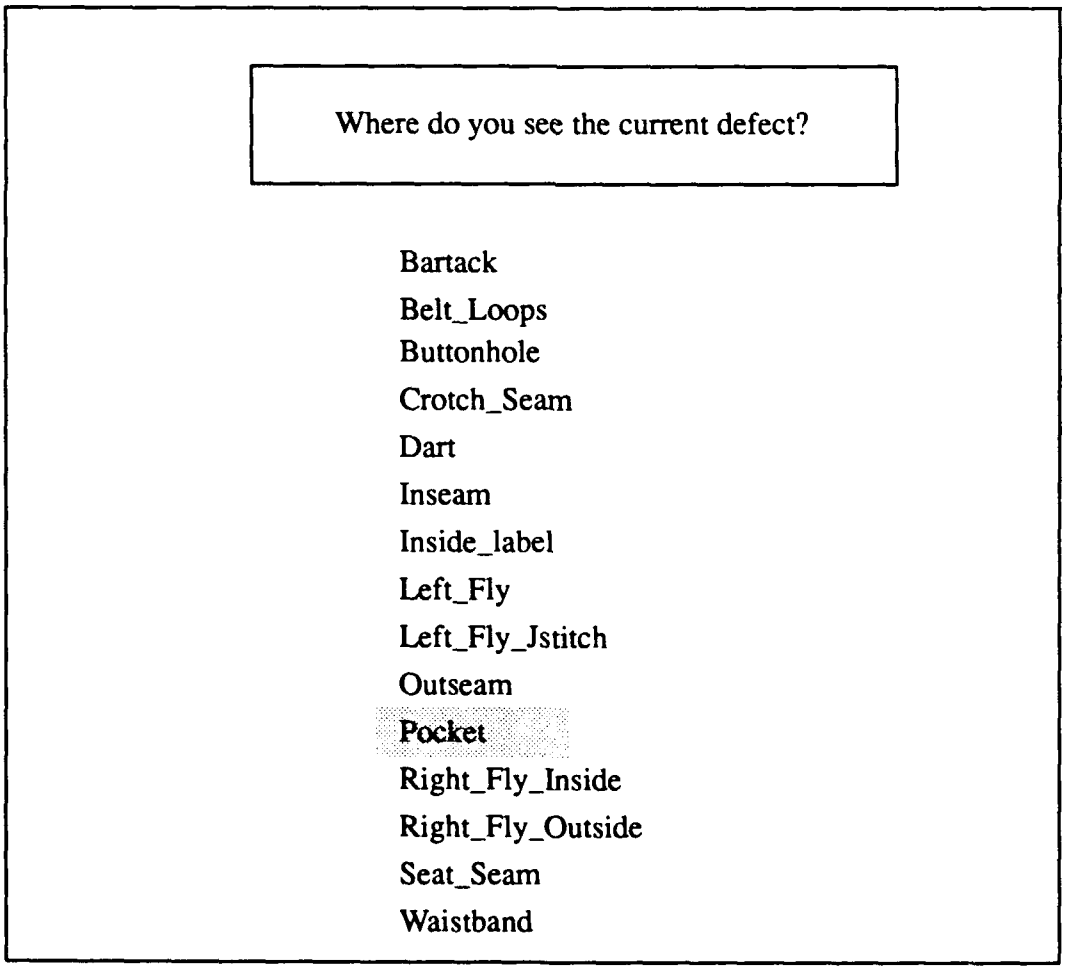

Figure 7. Defect Location Selection Screen

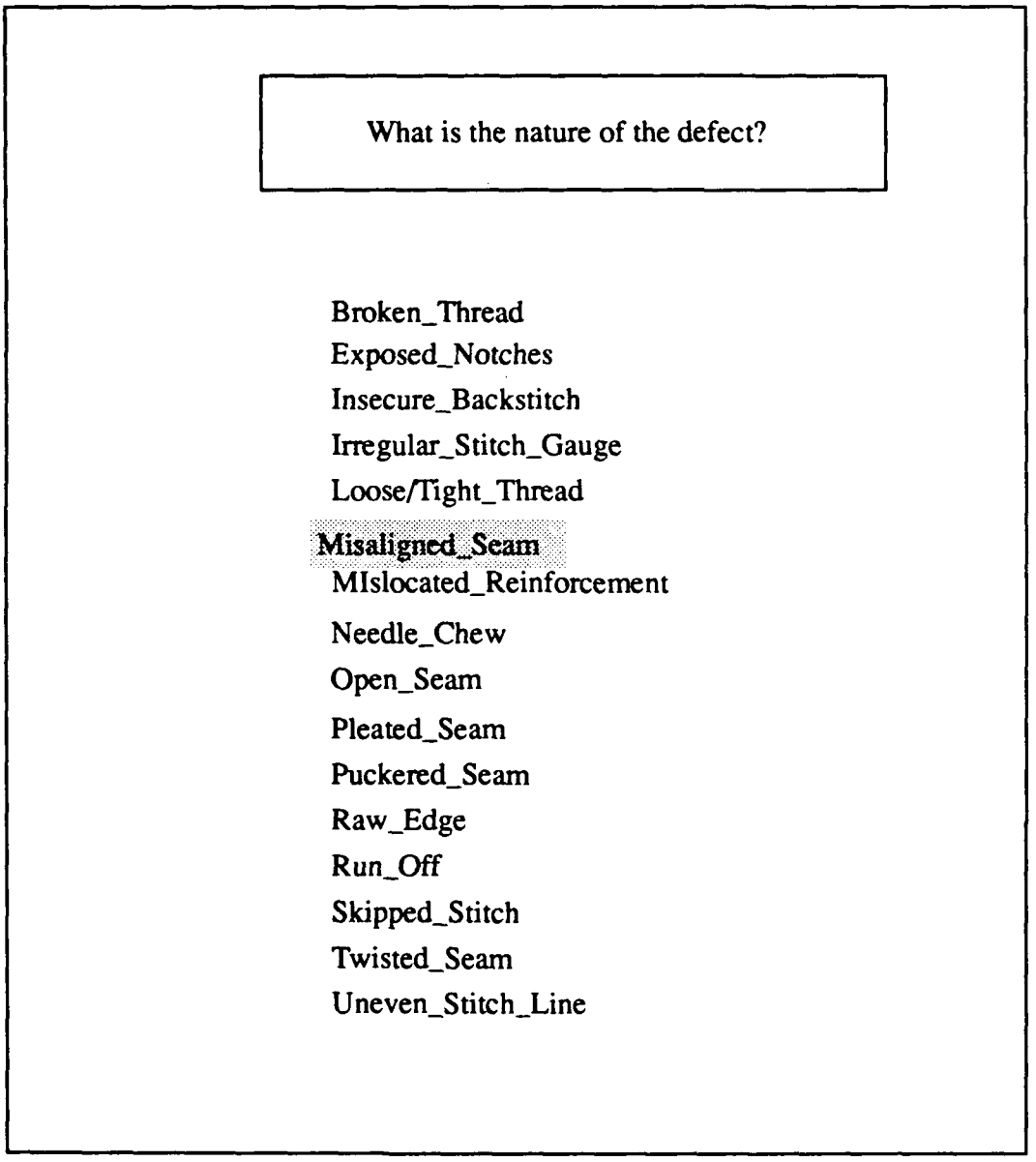

Figure 8. Screen for the Indication of Defect Type

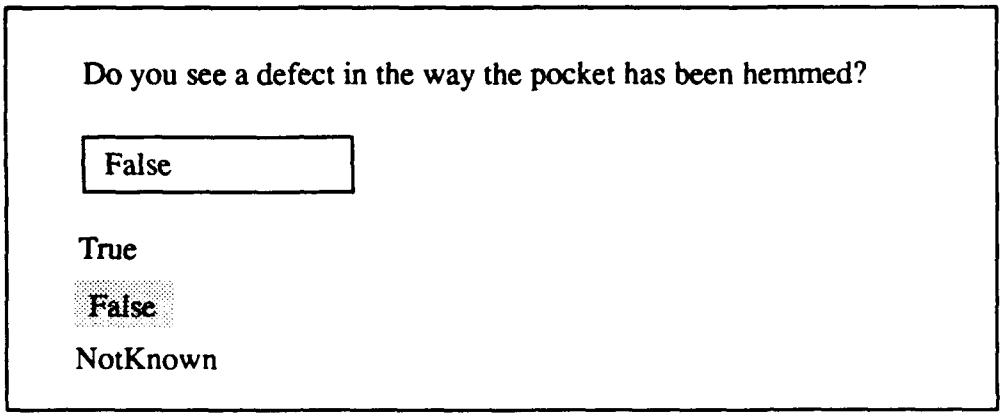

Figure 9. A Specific Question about the Defect Type

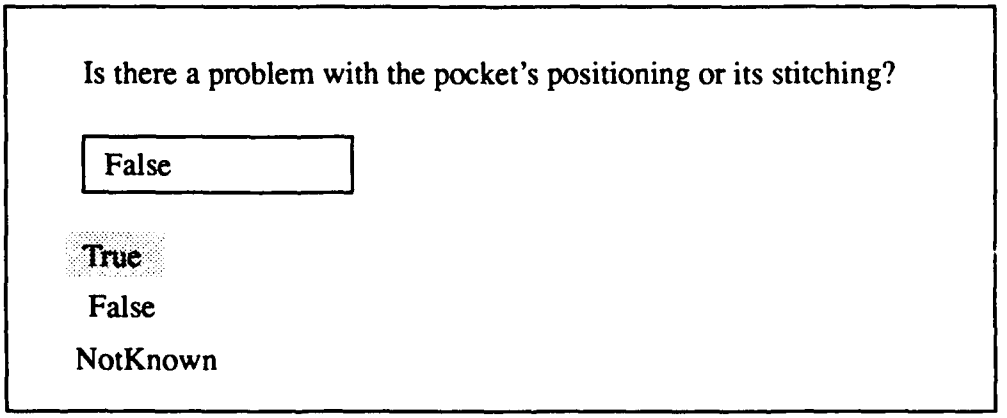

Figure 10. Another Specific Question about the Defect Type

Checkpoints for Needle Chew Defects, in general:

1. The first place to look is a broken or bent needle, or a burr on the needle. A broken needle would cause entry into the same small region of the fabric without any stitching since loop formation does not take place. A rough needle surface traps the fabric and pulls it out of the plane causing irregular feed and repeated stitching in a very small area.

2. The feed dog setting may be too low or too high. If it is set too low, this results in inadequate forward motion of the fabric at each sewing cycle. If it is set too high then there will be excessive backward feed of the material when the feed dog is on its return movement at the end of a stitch.

3. There may not be enough presser foot pressure to keep the fabric flat and feeding evenly despite the lateral forces exerted by the needle.

Checkpoints for Needle Chew Defects, at the Attach Patch Pocket Operation:

1. On an automatic pocket setter, the feed mechanisms must be verified to be working correctly. There should be no snagging of panel and pocket during the attachment operation which could restrict the movement of the pieces and cause the stitching to continue in a local area.

2. If there is a needle chew at one of the corner bartacks, it is almost always a broken needle that is the cause. The very high fabric thickness at these places may have caused the tacking needle to break.

Figure 11. Diagnosis from SDAS

Specification #1

Description:
Position patch pockets to their respective parts according to pattern marks. Fold under raw edges 5/16 to 3/8 inch and double stitch the sides and bottom edges of pockets through all plies.

Allowed Tolerance:
The pocket shape and space between bartacks (operation 14) for all sizes shall not vary more than 1/4 inch from the finished pocket template.

Seam Type:
Lapped, LSd-2

Stitch Type:
301, 401

Stitches/Inch (recommended):
8-10

Figure 12. Relevant Garment Construction Specifications (MIL-87062)

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