SECTION 1- INTRODUCTION

1.1 Introduction

For several years, the National Highway Traffic Safety Administration (NHTSA) has actively supported the development of an advanced frontal crash test dummy that incorporates improved biofidelic features and significantly expanded instrumentation. This development program, undertaken by GESAC in 1995, has resulted in the design and development of a test device for whole-body trauma assessment in a variety of occupant restraint environments. **Figure 1.1** shows a picture of the new, advanced frontal crash test dummy which has been named THOR (Test Device for Human Occupant Restraint). The primary design objectives of the development effort were as follows:

- Biofidelity in mass, size, surface geometry, and dynamic response
- Incorporation of specific instrumentation relevant to injury assessment
- Repeatability of performance
- Minimization of damage in severe test environments; i.e., overload protection
- Easy assembly and disassembly enabled by a modular user-friendly design

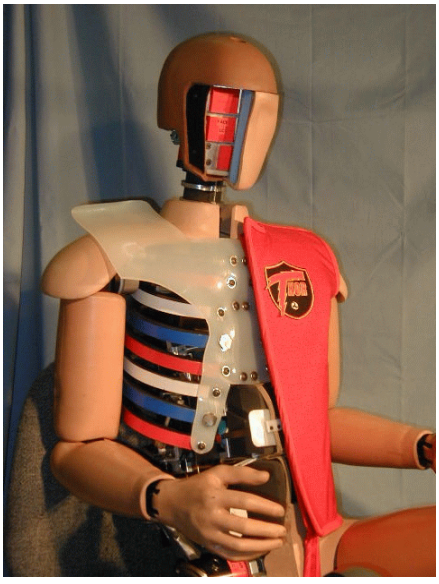

Figure 1.1- THOR frontal impact dummy.

The approach undertaken during the design of the THOR dummy was to first review the design elements which had been incorporated in the TAD-50M (the NHTSA funded predecessor to the THOR dummy). This review was conducted to identify needed improvements in biofidelity, dynamic response, and instrumentation. A systematic evaluation of design requirements for each body region was then accomplished. The design of THOR resulted in improvements to all the dummy components except the arms (which remain Hybrid III stock pending conclusion of arm development efforts ongoing within the automotive industry).

Figure 1.2 presents an assembly drawing of THOR indicating its primary new features. The facial region of the dummy has been instrumented with unidirectional load cells to assess the probability of facial fracture. The THOR neck assembly features multidirectional kinematic biofidelity, which results in more accurate head trajectories, velocities and accelerations for front, side, and rear impacts. The thorax region utilizes elliptical ribs which greatly enhance the biofidelity and geometry. A new thorax deflection sensor has been designed which measures the dynamic three-dimensional compression of the rib cage at four distinct points. In addition, a new

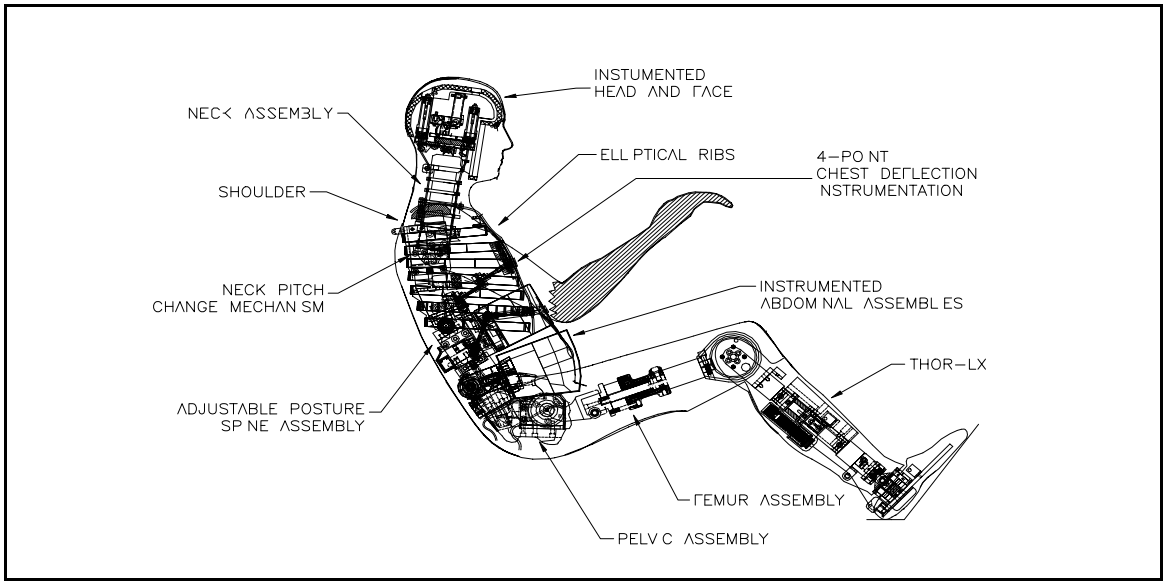

Figure 1.2- Primary features of the THOR dummy

abdominal assembly was developed that can directly measure belt intrusion in three dimensions at two distinct points at the lower abdomen and the compressive displacement at the upper abdomen from possibly an airbag. The pelvis has been instrumented with a three axis acetabular load cell at each hip joint and belt load sensors on each Iliac notch. The THOR femur assembly includes a compliant element to provide the correct force transmission for axial loading through the femur into the pelvic assembly. A new lower extremity (THOR-LX) has been developed which provides increased injury sensing capabilities in the foot, ankle, and lower leg, as well as, greatly improving the torque vs. angle relationship for the primary ankle rotation joints. In addition, the THOR dummy features many advances in sensors and instrumentation, and is capable of measuring over one hundred channels of data for injury assessment.

1.2 Introducing You to the User's Manual

This manual is designed to serve as a reference book for technical people working with the THOR 50% Male Crash Test Dummy. Each assembly of the THOR dummy has been described in great detail to assist the technical team in properly setting up and adjusting the dummy for testing. The user's manual has been divided into seventeen sections, as outlined below:

Section 1- Introduction
Section 2- Dummy Preparation and Use
Section 3- Face
Section 4- Head
Section 5- Neck
Section 6- Spine
Section 7- Thorax
Section 8- Shoulders
Section 9- Upper Abdomen Assembly
Section 10- Lower Abdomen Assembly
Section 11- Pelvic Assembly
Section 12- Femur Assembly
Section 13- THOR-LX
Section 14- Jacket and Clothing
Section 15- Instrumentation
Section 16- CRUX Units
Section 17- DGSP Units

1.2.1 Section Organization

Each section of this manual has been divided into the following general subsections to provide a complete overview of each assembly:

Description of Features
Assembly of Component or Assembly
Parts List
Assembly Procedure
Assembly of Component into THOR
Adjustments
Wire Routing and Electrical Connections
Certification
Inspection and Repairs

The assembly section of the manual assumes that the components have been disassembled to inspect or service the instrumentation or wear items. This assembly procedure is not designed for a complete strip-down of the component. Please refer to the THOR drawing

manual for details which are not covered in this section of the user's manual.

1.2.2 User's Manual Conventions

Right-hand and Left-Hand

The references to the right-hand and left-hand side of a component or assembly are made with the assumption that the component is installed within the dummy. Reference is made as if the laboratory personnel are oriented in the same position as the test dummy.

Front and Back

The references to front and back refer to the anterior and posterior sides of the part or assembly based on the dummy reference system.

Top and Bottom

The reference to top and bottom refer to the superior and inferior sides of the part or assembly based on the dummy reference system.

Dummy Coordinate System

All references made to the coordinate system of X, Y, and Z will be based on the SAE Information Report J1733 - Sign Convention for Vehicle Crash Testing. This SAE sign convention is provided below:

+X is toward the Anterior or front of the dummy
+Y is laterally toward the right
+ Z is toward the inferior or bottom of the dummy