

18 kg Ejection Mitigation Featureless Headform

P/N 92041-101-FT

The National Highway Traffic Safety Administration (NHTSA) has adopted a new final rule for ejection mitigation, Federal Motor Vehicle Safety Standard 226 Ejection Mitigation (FMVSS 226) in an effort to reduce ejections of occupants in side impact and rollover crashes. The new rule's phase-in period will be complete in 2017.



Overview

In 1991 the National Highway Traffic Safety Administration (NHTSA) initiated research programs concerning motor vehicle rollover protection. As part of that research, NHTSA conducted a crashworthiness research program to evaluate ways to reduce the number of fatalities due to ejection from the vehicle. The program was then expanded from side impact ejections to include ejections from rollover, front, and rear impacts.

On, November 30, 2006, NHTSA released a Memorandum to explain the test procedure guidelines for automotive manufacturers to

use for research into the performance of ejection mitigation counter-measures (docket NHTSA-2006-26467). The guideline does not represent a regulatory or compliance test procedure but was put in place for the manufacturers to replicate as an option.

In response to this Memorandum, Humanetics was approached to supply the 18 kg headform required for this test procedure. The Ejection Mitigation headform was originally produced back in 1988 but was discontinued in 1991. New molds and castings were recently created and Humanetics has launched the headform back into production.

Description

The 18 kg headform consists of a vinyl skin on an aluminum skull with a steel back plate in place of a skull cap. The skull accommodates an accelerometer mount and the back plate is designed to be machined to attach to the user's impactor device. The head assembly mass is approximately 4.6 kg. 18 kg is the mass of the headform plus the moving mass of the impactor. This is the effective mass of the human head and shoulders.

Featureless Face Form

The 18 kg head has a featureless face to simplify contact interactions. The form of the face is a surface of revolution formed using a 3rd degree polynomial curve equation, $(\frac{x}{X_0})^2 + (\frac{z}{Z_0})^3 = 1$. The upper quadrant is the region where X and Z are both positive. This part of the curve is reflected about the plane Z = 0 to form the lower quadrant. The entire curve is rotated plus and minus 90 degrees from the mid-sagittal plane, Y* = 0, to form the front surface of the head.

Technical Specifications

Dimensions

Parameter	Spec. (in, +/- .1)	Spec. (meter) (ref.)
Height	8.90	.226
Width	6.96	.177
Length	5.68	.144

Summary Chart

Feature	X Location		Y Location	Z Location	
Origin Reference Point	Skull-Head Back Mating Surface		Mid-Sagittal Plane	Machined Surface Underside of Skull Horizontal Plate	
Head Coordinates	2.2 in.	56 mm	0.0	.8 in.	20 mm
Test Lab Impact Line	n/a	n/a	0.0	.8 in.	20 mm
Vehicle Impact Test Location	n/a	n/a	0.0	1.8 in.	46 mm
Accelerometer A.I.P.	2.2 in.	56 mm	0.0	1.8 in.	46 mm
Center of Gravity	2.13 in.	54 mm	0.0	1.46 in.	37 mm

Specifications

Parameter	Spec.
Headform Mass (w/Accelerometers and Mount)	4.18/5.08 kg
*CG-X forward from skull-cap mating surface	.0490/.0592 m
*CG-Y to the left from MSP	-.0051/.0051 m
CG-Z upward from lower horizontal machined surface	.0320/.0422 m

Humanetics Lab Test Parameters

Parameter	Spec.
Probe Mass	12.00±.026 kg
Probe Velocity	1.10/1.30 m/s
Probe Force	7.0/10.0 kN
Temperature	20.6/22.2 °C
Relative Humidity	10/70 %

Technical Specifications



Figure 1. Headform - Oblique Front



Figure 2. Headform - Oblique Rear

Technical Specifications

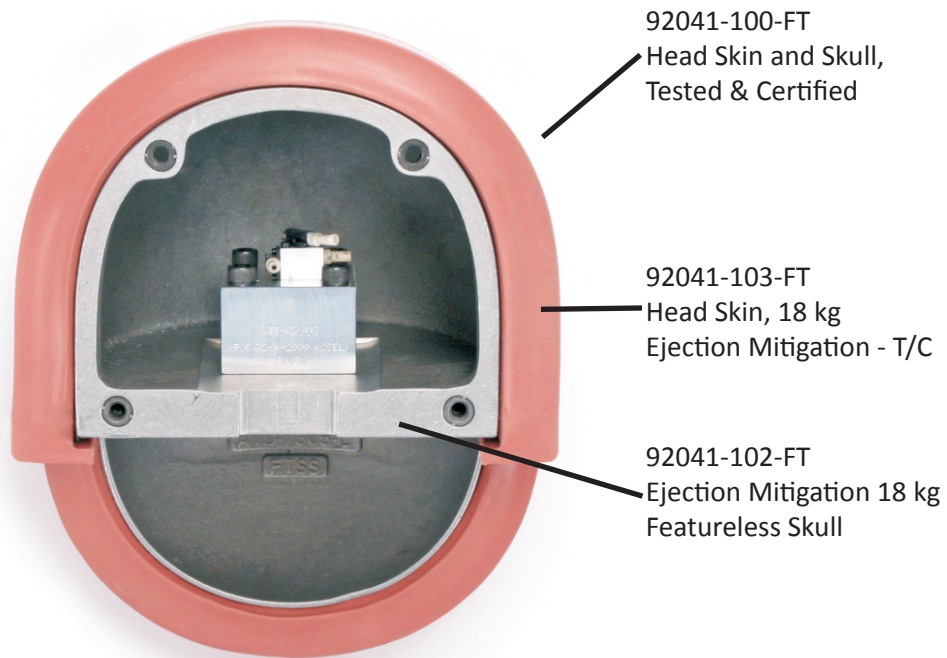


Figure 3. Headform - Back Plate Removed

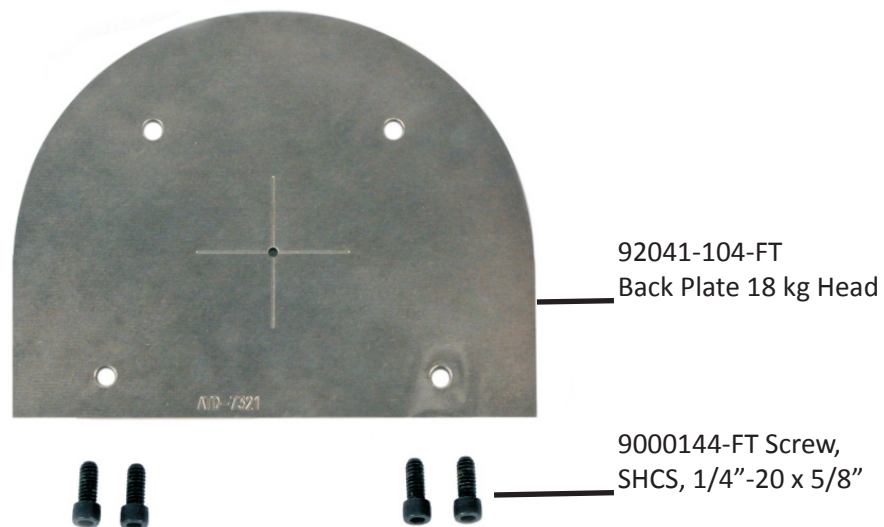
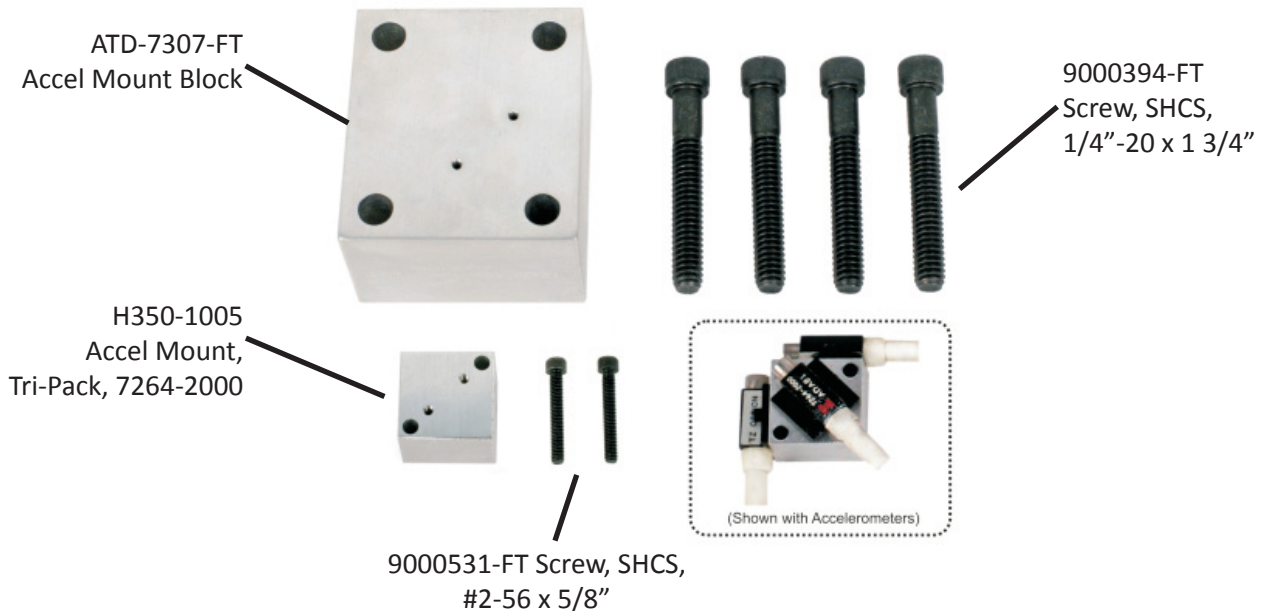


Figure 4. Headform Back Plate and Attaching Screws

Technical Specifications



Assembly Part No.: 1032437 Accel Mount Kit, 7264-2000

Figure 5. Accelerometer Mount Kit

Lab Tests and Vehicle Certification

Head Coordinates and Lab Test Impact Line

The head coordinate system is the center of the surface generated by the polynomial curve equation. The headform is tested in the lab to control the headskin material and achieve uniformity. The head back is replaced by a test fixture TE-530-106 which mounts the head to a force gauge. The gauge is mounted to a rigid frame so that the head does not move during impact. A 12 kg probe impacts the head in line with the center of the head coordinate system and the gauge measures the force imparted to the head. The gauge and the impact probe are centered on the geometrical centerline of the headform laterally (Y) and vertically (Z). This results in the probe hitting the most forward part of the front surface of the head to produce maximum contact instead of a glancing blow.

Technical Specifications

Lab Tests and Vehicle Certification (Con't)

Vehicle Certification Test Impact Location and Axial Intersection Point of Accelerometer Sensitive Axes (A.I.P)

In a vehicle test guided impact the headform is secured by its back plate (ATD-7321) to a steel shaft running in a linear bearing. The center of the rod is aligned with the vertical and lateral centerline of the four bolt hold pattern that holds the head back to the skull. This alignment provides maximum strength of attachment during the impact. The 1/8 inch (~3.2 mm) diameter hole in the back plate is used to locate the shaft attachment center. The axial intersection point (A.I.P.) of the sensitive axes of the three accelerometers mounted in a triaxial array is aligned laterally (Y axis) and longitudinally (X axis) with the head coordinate system. Vertically (Z axis), it is aligned with the centerline of the impact shaft.

Center of Gravity

The 18 kg head is used in a guided impact running in the X direction only. Head CG does not affect the test results.

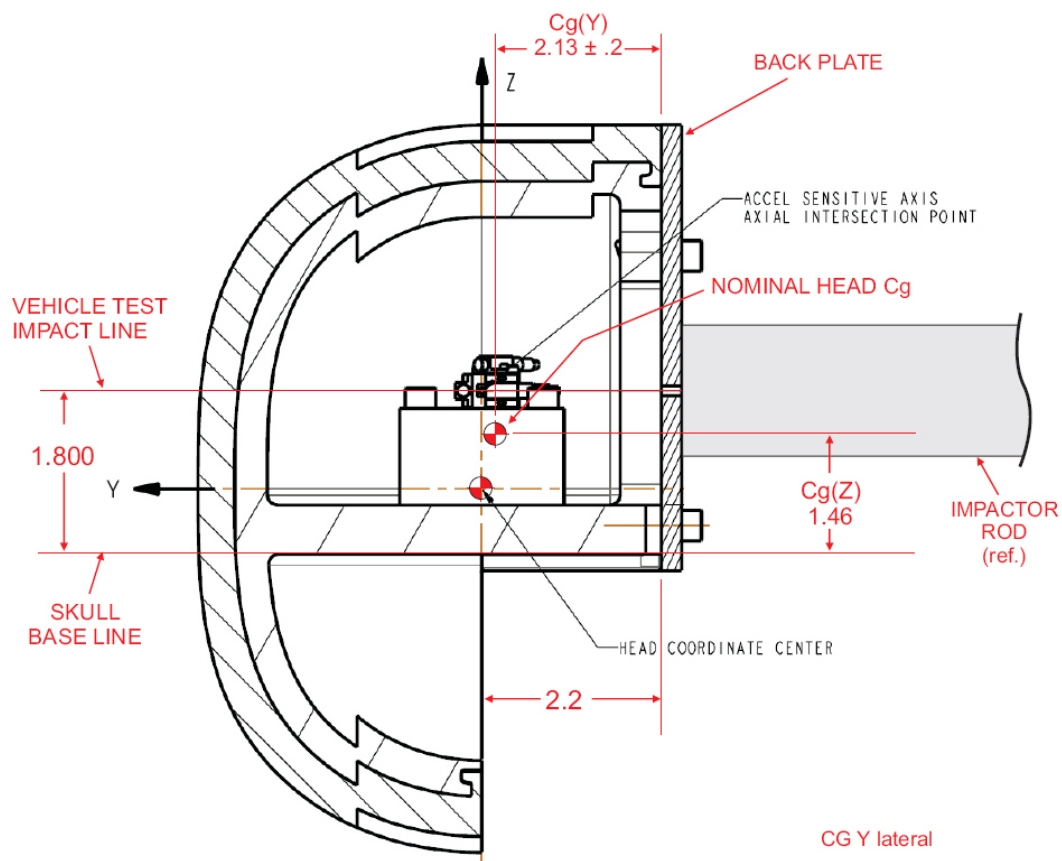


Figure 6. Vehicle Impact Setup

Technical Specifications

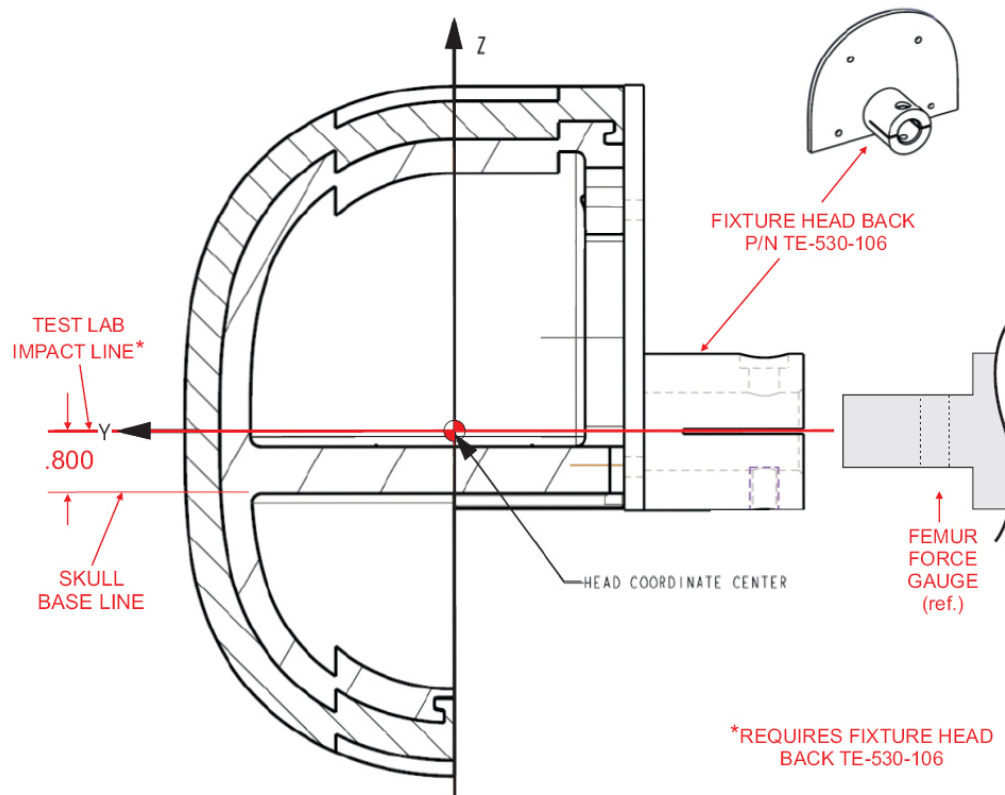


Figure 7. Test Lab Impact Setup

NHTSA Application

In preparation for a test, the side door glass is pin-punched according to a prescribed scheme. This is to weaken the glass during the test, as it has been observed that the side door glass frequently breaks out in a rollover accident.

The vehicle is then set on blocks and the Impactor assembly is set up to propel the head on the impactor rod through the window opposite the glass to be tested. The side curtain airbag is inflated and the impactor rod is moved forward so the head touches the bag. The deflection measurement device is then zeroed, the airbag is deflated, and the head is pulled back. A rollover incident is then simulated in the vehicle computer. The impactor launches the head at 16 to 24 km/h into the airbag which is re-inflated by the vehicle computer using compressed air. A delay dependent upon the vehicle's simulated velocity is programmed into the head impactor mechanism. In a successful test the head moves less than 100* mm past the zero point, indicating head retention inside the vehicle.

Technical Specifications



Figure 8. Headform Mounted on Impactor
Photo courtesy of NHTSA



Figure 9. Impacted Vehicle Window
Photo courtesy of NHTSA

!WARNING

MISUSE OF DOCUMENTATION

- The information presented in this product sheet (or catalog) is for reference only.
- DO NOT USE this document as product installation information.
- Complete installation, operation and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

!WARNING

PERSONAL INJURY

These products are to be used solely as test devices.

DO NOT USE these products as safety stop devices or emergency stop devices, or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.