ENGINEERING DRAWING AND
RELATED DOCUMENTATION PRACTICES

ASME Y14.32.1M-1994
(REVISION OF ANSI Y14.32.1-1974)

REAFFIRMED 1999

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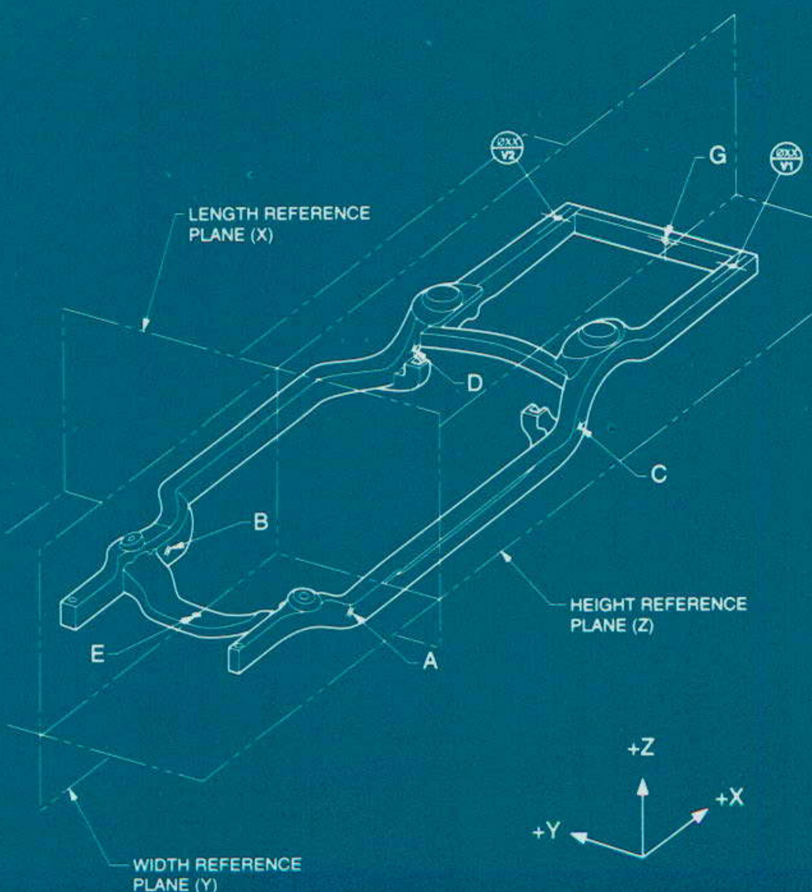
Chassis Frames — Passenger Car and Light Truck — Ground Vehicle Practices



AN AMERICAN NATIONAL STANDARD

The American Society of
Mechanical Engineers

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ENGINEERING DRAWING AND RELATED DOCUMENTATION PRACTICES

Chassis Frames — Passenger Car and Light Truck — Ground Vehicle Practices

ASME Y14.32.1M-1994

(REVISION OF ANSI Y14.32.1-1974)

The American Society of Mechanical Engineers

345 East 47th Street, New York, N.Y. 10017

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

FOREWORD

(This Foreword is not part of ASME Y14.32.1M-1994.)

Subcommittee 32 of the ASME Standards Committee Y14, Engineering Drawing and Related Documentation Practices, was organized in 1968. The work of the Subcommittee resulted in the publication of the predecessor to this Standard, ANSI Y14.32.1-1974. During the ensuing years, the Y14 Committee, reacting to the increasing acceptance of the SI metric system in the United States, began to systematically update its existing standards to accommodate metric practices. Since Y14 drafting practices in most cases are dimensionally insensitive, the majority of the metrication effort involved redrawing examples using metric units. ANSI Y14.32.1 was withdrawn as an American National Standard in 1987, at which time work on this Standard began.

The vehicle chassis frame is typically an inseparable assembly of stamped or formed sheet metal structural members which support and locate the vehicle body, front sheet metal structure, chassis components (wheel, suspension, engine, steering components, drive line, exhaust system, bumpers), and miscellaneous equipment. The chassis frame provides accuracy of location as well as strength and rigidity of support for these components to assure satisfactory vehicle performance. Functional criteria and restraints are determined from a number of support drawings and a design check mock-up. These include a definition of mountings and clearances for all related chassis and underbody components, such as underbody and sheet metal structure, engine, drive line, exhaust, suspension systems, tires, brake lines, fuel lines, and bumpers.

In addition to referencing metric (SI) units, this Standard includes the definition of some key terms which are generally accepted in the industries producing ground vehicles. References are made specifically to automobiles, vans, and trucks where such distinctions are necessary. References to *vehicles* are inclusive of all types, as the concepts are generic.

References to rear suspensions are more general than in the previous standard. Since 1974, the number of types of rear suspensions in use has increased beyond the ability of this Standard to adequately cover all applications.

This Standard has been prepared for application with any system of measurement.

Suggestions for improvement of this Standard will be welcomed. They should be sent to The American Society of Mechanical Engineers, Secretary, Y14 Main Committee, 345 East 47th Street, New York, NY 10017.

This Standard was approved as an American National Standard on September 6, 1994.

ASME STANDARDS COMMITTEE Y14
Engineering Drawing and Related Documentation Practices

(The following is the roster of the Committee at the time of approval of this Standard.)

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CHASSIS FRAMES — PASSENGER CAR AND LIGHT TRUCK — GROUND VEHICLE PRACTICES

1 GENERAL

1.1 Scope

This Standard establishes minimum requirements for the preparation of engineering drawings for passenger car and light truck chassis frames.

This Standard does not apply to heavy truck, trailer, tractor, and off-the-road vehicle chassis frames.

1.2 Units

The International System of (Metric) Units (SI) is featured in this Standard because SI units are expected to supersede United States (U.S.) customary units specified on engineering drawings. Customary units could equally well have been used without prejudice to the principles established.

1.3 Notes

Notes herein in capital letters are intended to appear on finished drawings. Notes in lower case letters are explanatory only and are not intended to appear on drawings.

1.4 Reference to Gaging

This Standard is not intended as a gaging standard. Any reference to gaging is included for explanatory purposes only.

1.5 References

When the following American National Standards referred to in this Standard are superseded by a revision approved by the American National Standards Institute, Inc., the revision shall apply.

ASME Y14.5M-1994, Dimensioning and Tolerancing

ASME Y14.24M-1989, Types and Applications of Engineering Drawings

Y14.31M (in preparation), Undimensioned Drawing Practice

1.6 Definitions

The following are defined as their use applies in this Standard.

1.6.1 Vehicle Mounts (Body and Front Sheet Metal). The area where the body and chassis frame contact. This contact is made through rubber insulators, retained with fasteners.

1.6.2 Box Mounts. The location where a truck box is rigidly mounted to the vehicle frame.

1.6.3 Compression (Jounce) Position. The position of vehicle suspension travel which represents the allowable compression of the suspension. Generally, the springs are not fully compressed, but the travel is limited by stops or bumpers.

1.6.4 Design Check Mock-Up. An assembly (usually full scale) of components used to verify the design. These components may be actual production or representative parts made of fiberglass, cardboard, plastic, or other easily formed materials. This mock-up is used to check for clearances and interferences and as a visual aid for the designer when mounting or routing other components.

1.6.5 Design Load. A value assigned to a vehicle to represent a nominal load.

1.6.6 Design Position. The position of vehicle suspension travel at which the vehicle is designed. This position represents the design load.

1.6.7 Front Suspension Arm. Components of the vehicle suspension, mounted between the frame and steering knuckle, which allow vertical movement of the wheel assembly.

1.6.8 Rebound Position. The position of vehicle suspension travel which represents the fully extended travel of the components of the suspension. This travel is usually limited by the full extension of the shock absorbers, or rebound stops.

1.6.9 Steering Knuckle. A component of the vehicle suspension which acts as a pivot for the front wheel assembly.

1.6.10 Suspension. An assembly of components connecting the wheels to chassis frame, thus positioning or supporting the frame and body in space. The suspension is dynamic, attenuating the effect of uneven road surfaces.

1.6.11 Wheelbase. The distance between the center of the front and rear wheels.

2 DRAWING TYPES

The following are the drawing types used to describe a chassis frame. See ASME Y14.24M.

2.1 Layout Drawing

A precision undimensioned or partially dimensioned design layout is made on a computer or a dimensionally stable drafting film. See Y14.31M. Usual practice is to show the left half of the plan (top) view with the frame centerline across the top of the layout, and the left side (elevation) view directly beneath. The layout shall include sufficient vehicle interface reference information to adequately define functional fit and clearance requirements. All frame components shall be shown on the layout to completely satisfy all functional requirements.

2.2 Monodetails

Individual detail drawings are usually prepared for each frame part to accommodate all phases of manufacturing. Each part shall be sufficiently defined, functionally dimensioned, and toleranced, to permit it to perform all assembly and functional requirements and meet design intent.

2.3 Assembly Drawings

Assembly drawings of two or more components are usually prepared as required by manufacturing, and also to provide for service requirements. Dimensioning shall be sufficient to assemble and verify the relationship of parts involved.

2.4 Assembly Drawing (Complete Frame)

The end product assembly drawing of the complete vehicle chassis frame is prepared to facilitate final assembly and inspection. The drawing shall include sufficient information to facilitate subsequent manufacturing steps and define the structure adequately. The following information is usually included:

(a) material specifications and component identification

(b) definition of the datum reference frame (see para. 4)

(c) final assembly welding, riveting, and torque specifications

(d) final assembly dimensions and tolerances

(e) functional check/inspection procedures and tolerances

(f) paint and other corrosion protection specifications

3 DRAWING GRID SYSTEM

The 100 mm grid line system of reference in all planes as defined in Y14.31M is used in preparing chassis layouts. Chassis layout datum planes are usually coincident with body layout datum planes, except for the height reference plane (*Z*), which may differ in elevation by several millimeters. Ideally, the frame layout datum reference frame is chosen to coincide with the chassis layout datum reference frame. An overriding consideration, however, is the desirability for locating datum planes to intersect major structural components. Since the chassis height reference plane (*Z*) is often 150–250 mm below the frame, the best choice for a frame layout height reference plane (*Z*) location is coincident with the chassis layout 150–250 mm plane, whichever intersects the vertical face of the major portion of the frame side member. Similarly, the zero length reference plane (*X*) should be chosen to intersect a portion of the frame front side member or front engine cross member having a surface parallel to the width reference plane (*Y*) and near the front suspension mounting area. This is often 250 mm or more forward of the chassis length reference plane (*X*) (*front of dash*). The interrelationship between chassis and frame reference planes shall be called out on the frame layout and assembly drawing as reference information.

4 DATUM REFERENCE FRAME

The datum reference frame is established on frame assemblies through a system of datum features located in major structural members as close as possible to important functional features, such as suspension and steering mountings, to assure good dimensional control of these features, in accordance with ASME Y14.5M. See Fig. 1. Depending on the structural rigidity of the particular design under consideration, the datum reference frame is established according to either rigid structure or semirigid structure practice, or both. In rigid structure practice, height (*Z*), length (*X*), and width (*Y*) reference planes are established by datum features *Z* and *Y*. Datum feature *Z* (holes *A*, *B*, and *C*) establishes the *Z* plane and hole *A* also establishes the *X* plane. Datum feature *Y* (holes *E* and *F*) establish plane *Y*. In semirigid practice, additional datum features and/or datum target areas are employed.

4.1 Rigid Structure Practice

Where frame structures are not designed to be compliant, the following restraints are used.

4.1.1 Height Reference Plane (*Z*). Two holes in each side member inner rail web, generally cupped for accuracy when the part is formed, shall be located near the front and rear suspension mountings as shown in Fig. 1. Plane *Z* is established by holes *A* and *B* in the front, and hole *C* in the rear.

4.1.2 Width Reference Plane (*Y*). Plane *Y* is established by holes *E* and *F* on the center plane of the frame and is perpendicular to the height reference plane (*Z*). The two holes which are datum feature *Y* should be located in the front and rear suspension cross members on the frame center plane. See Fig. 1. In some frame designs, the center plane at the rear is established by equalizing the side rails in the rear suspension area.

4.1.3 Length Reference Plane (*X*). Plane *X* is mutually perpendicular to planes *Y* and *Z* and is established by hole *A* in the left side member or hole *E* in the front engine cross member. See Fig. 1.

4.2 Semirigid Structure Practice

Where frame structures are designed to be compliant, additional restraint is recommended relative to the *Y* and *Z* planes.

4.2.1 Height Reference Plane (*Z*). Hole *D* in the side member, and frame surfaces *V1* and *V2* around the body/box mount holes at the rear of the frame, as shown in Fig. 1, are specified to provide vertical restraint in addition to the holes marked *A*, *B*, and *C* used in the rigid structure practice defined in para. 4.1.2.

4.2.2 Width Reference Plane (*Y*). Hole *G* on the frame center plane is specified to provide lateral restraint in addition to the rigid structure practice defined in para. 4.1.2. See Fig. 1. The rear side rail body/box mounts are moved to nominal location in frames without a rear cross member to establish the rear center plane.

4.3 Combined Rigid and Semirigid Practice

The vehicle frame is often structurally compliant to the rear of dash compared with the relatively rigid body structure to which it is bolted. Consequently, rigid structure practice is specified for application to a limited number of dimensions for controlling frame distortion in the free state (unrestrained condition). All other dimensions are specified under semirigid practice. Recommended notation and dimensioning technique for combination of these practices is shown in Fig. 2.

5 SPECIAL CONSIDERATIONS

The following are features which require special dimensioning and tolerancing.

5.1 Front Suspension Mounting

Dimensional control of the front suspension mounting points on the frame assembly is important primarily with respect to the following:

(a) fit of suspension components on frame

(b) rotation of these components in space to yield desired steering knuckle orientation and location (suspension geometry)

Suspension geometry is a function of the dimensional interrelationship of frame mounting points. Control of suspension geometry can be achieved effectively by directly tolerancing the steering knuckle orientation and location, to be measured with functional checking equipment, or equivalent computer system, designed to simulate the suspension arms and steering knuckle. Check of the knuckle orientation in three positions of wheel travel (design, compression, and rebound), and its coordinate location in space, provides complete control of suspension geometry. See Fig. 3. Coordinate dimensioning of each frame mounting point is therefore unnecessary except when required by overriding considerations such as mechanical fit of suspension arms.

5.1.1 Functional Checking. For functional checking purposes, the steering knuckle is defined as a line connecting the upper ball joint center (*U*) and lower ball joint center (*L*) (or equivalent), line *U–L* in Fig. 3. *Camber angle* is defined as the inclination of line *U–L* in front view, angle *A*; and *caster angle* as the inclination of line *U–L* in side view, angle *B*. Inboard displacement of point *U* relative to point *L* is positive camber. Aft displacement of point *U* relative to point *L* is positive caster. Both camber and caster angles are specified and toleranced on the product drawing for three positions of wheel travel — design, compression, and rebound. These positions are identified as height settings for the functional gage lower ball joint center, point L in Fig. 3.

5.2 Rear Suspension Mountings

Dimensional control of the rear suspension mounting points on the frame assembly is important primarily with respect to the fit of the suspension components on the frame and the components in space in order to provide the desired axle and/or wheel assembly location and orientation. Location of the rear suspension mounting points is controlled by functionally tolerancing and gaging the position and orientation of the rear suspension components. Recommended practice is to locate all functional mounting points and the wheel centers with basic dimensions and appropriate geometric tolerances. This will control the characteristics of wheelbase, track, pinion angle, stagger, roll steer, caster, and camber as required depending on the design of the rear suspension.

5.3 Bending Deflection Compensation

Chassis component layouts which include frame assemblies are prepared in the design load position. Suspension spring deflections due to the design load are accounted for on the layout, but structural members are treated as rigid, that is, deflection under load is ignored. To avoid needless compensation, frame side rails are also detailed in the design load position, ignoring structural deflection due to design load. Deflection due to design load must be considered in the finished frame to avoid problems of suspension geometry and body and sheet metal fits. Compensation is designed into the frame assembly by creating an adjusted or cambered side view datum line that deviates from the height reference plane (Y) at one or two break points located at the junction of major structural members. Vehicle frames having front and rear torque boxes, and those having one piece center-to-center side rails can be specified for a single break point. Recommended method for specifying deflection compensation is shown in Fig. 4.

6 DESIGNATION OF PASSENGER CAR AND VAN BODY MOUNT LOCATIONS

Body-to-frame mountings are designated according to a system relating to their function in supporting portions of the vehicle body.

6.1 Identification and Location

(a) Front sheet metal mount — forward support of front sheet metal structure assembly

(b) #1 body mount — dash or front toe board support

(c) #2 body mount — front hinge pillar support

(d) #3 body mount — front seat, center pillar support

(e) #4 body mount — rear seat cushion support

(f) #5 body mount — rear seat back support (top of frame kickup)

(g) #6 body mount — rear wheel house, trunk, fuel tank support (to the rear of frame kickup)

(h) #7 body mount — extreme rear end of body

6.2 Omission of Body Mounts

The fact that some of these locations may be omitted on a particular vehicle does not affect the identification number selected for a given mount. When more than one mount is used at one location, letter suffixes are used, such as outboard mount at dash, #1 body mount; inboard mount at dash, #1A body mount. Right and left mounts carry the same identification at a given location.

7 DESIGNATION OF TRUCK BODY AND BOX MOUNTS

Body-to-frame and box-to-frame mountings are designated according to a system relating to their function in supporting portions of the truck body and box.

7.1 Identification and Location

(a) Front sheet metal mount — forward support of front sheet metal structure assembly

(b) Front cab mount — front cab location

(c) Intermediate cab mount — intermediate cab location for trucks with extended cabs only

(d) Rear cab mount — rear cab location

(e) Front box mount — front box location

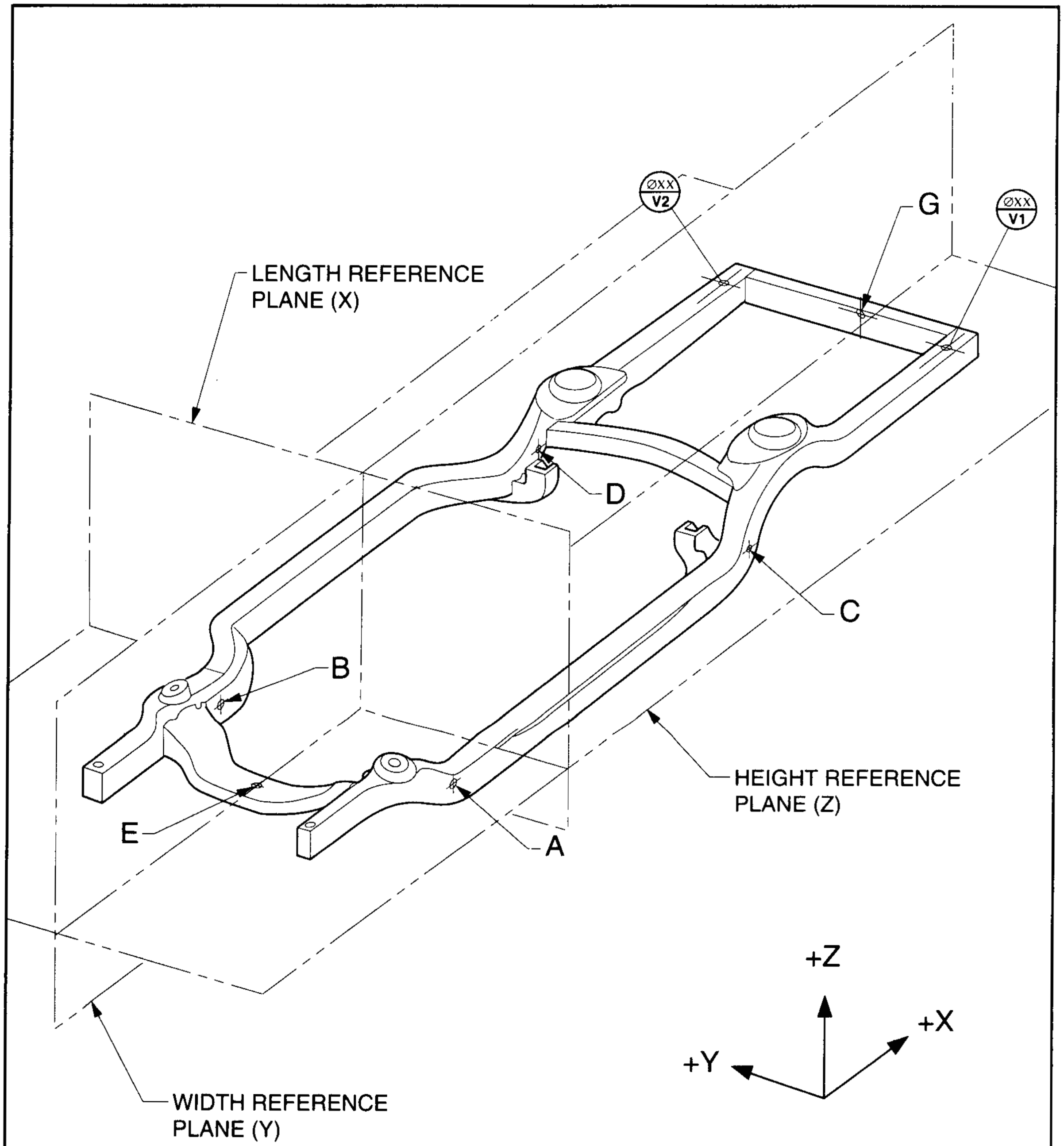
(f) Front intermediate box mount — front intermediate box location (optional)

(g) Rear intermediate box mount — rear intermediate box location (optional)

(h) Rear box mount — rear box location

7.2 Omission of Body and Box Mounts

The fact that some of these locations may be omitted on a particular vehicle does not affect the identification selected for a given mount. Right and left mounts carry the same identification at a given location.



DATUM TARGETS

RIGID PRACTICE	SEMIRIGID PRACTICE
plane Z — holes A, B & C	plane Z — holes A, B, C & D and Datum Targets V1 & V2
plane Y — holes E & F	plane Y — holes E, F & G
plane X — hole A or E	plane X — hole A or E

FIG. 1 DATUM REFERENCE FRAME

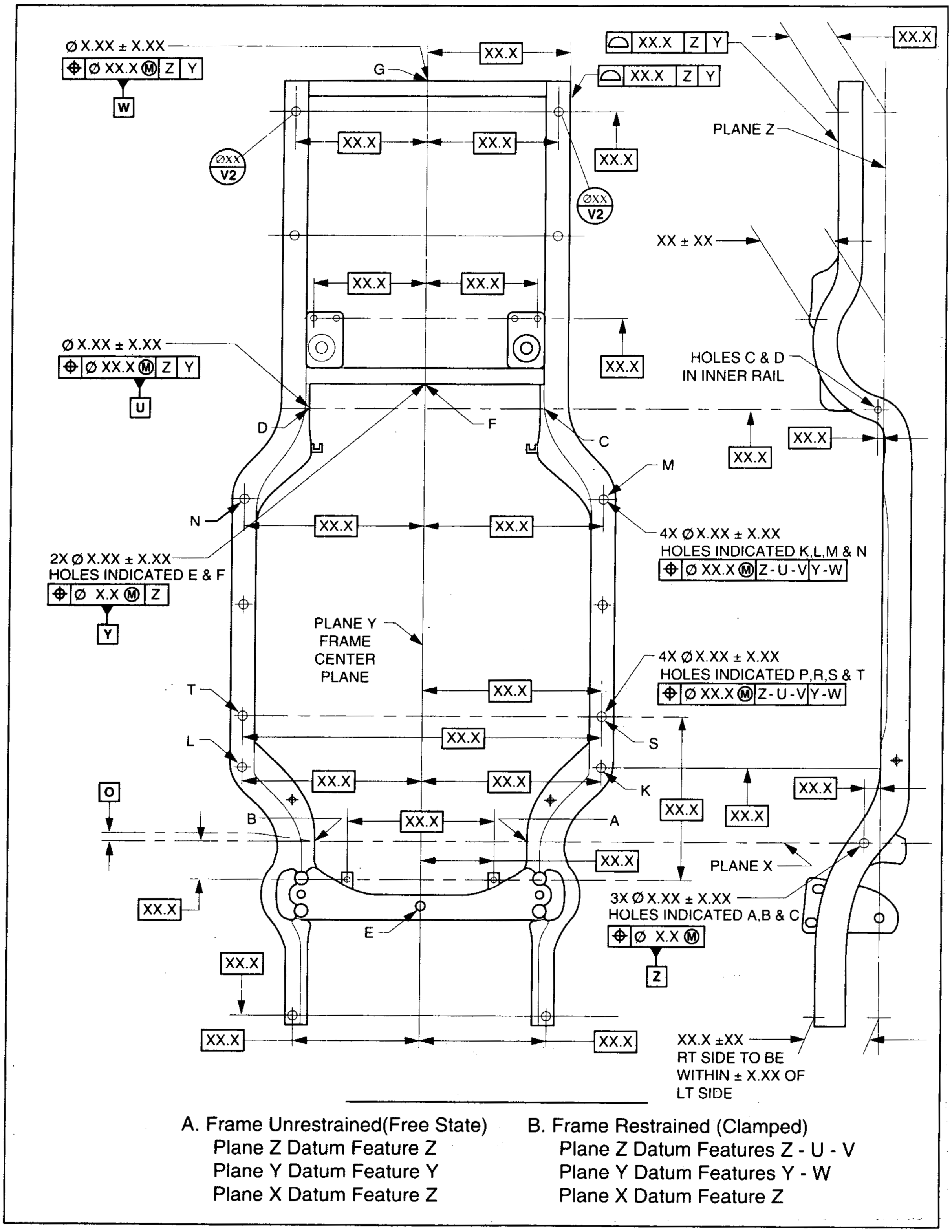
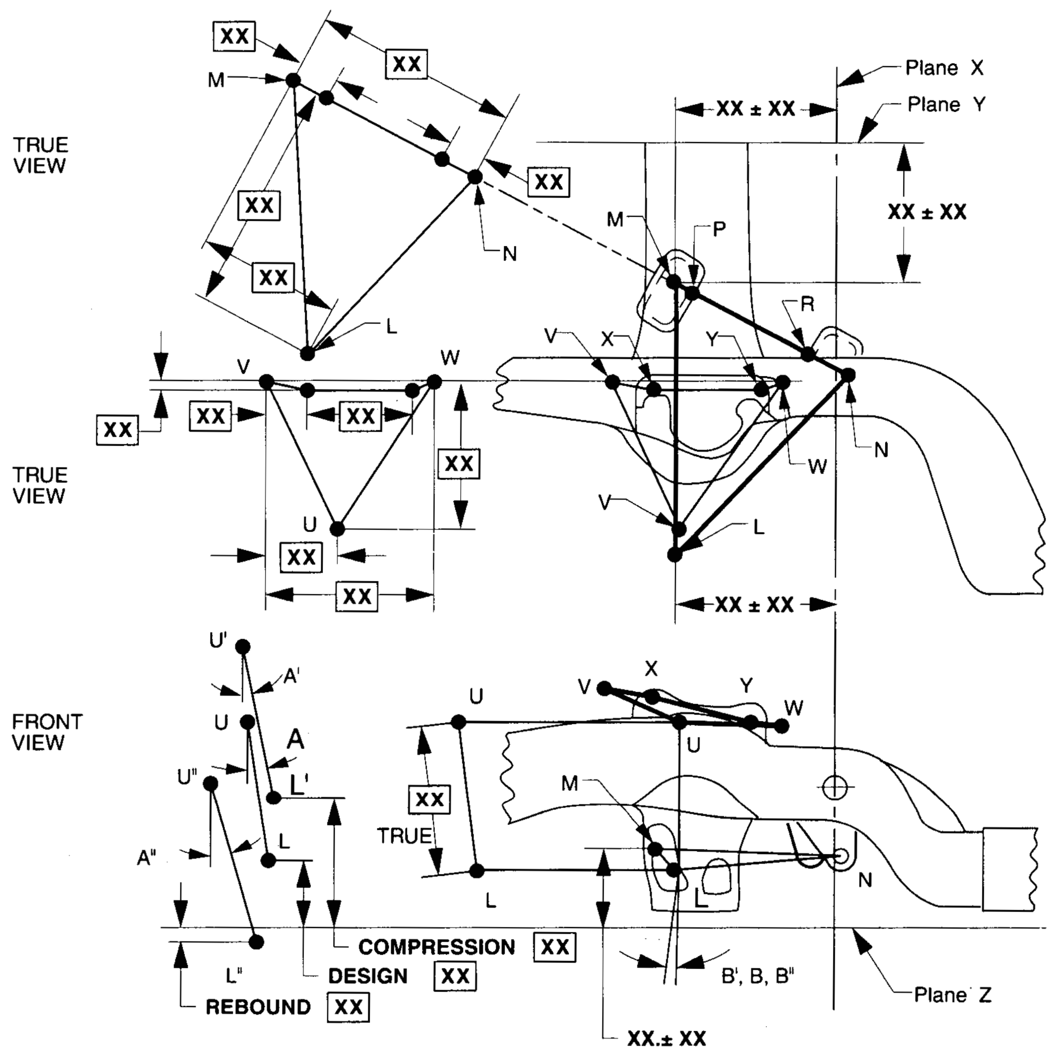


FIG. 2 RECOMMENDED NOTATION AND DIMENSIONING TECHNIQUE



1. Specify basic dimensions $\boxed{XX}$ of functional gage which simulates front suspension components, lower control arm MLN, upper control arm VUW and steering knuckle UL.

2. Specify travel $\boxed{XX}$ of gage steering knuckle point L from Z datum plane for 3 positions of design L, compression L, and rebound L.

3. Dimension and tolerance lead point M from X, Y and Z datum planes and point L from X datum plane.

WITH FUNCTIONAL GAGE ATTACHED TO FRAME AT POINTS X, Y, M AND N AND HOLDING POINT L AT DESIGN POSITION IN THE Z PLANE, LOCATION OF POINT L IN THE X PLANE TO BE AS SPECIFIED.

WITH POINT L SET AT 3 POSITIONS SHOWN CASTER AND CAMBER ANGLES TO BE:	POSITION		CASTER		CAMBER
	COMPRESSION	B'	X.X° ± 0.X°	A'	X.X° ± 0.X°
	DESIGN	B	X.X° ± 0.X°	A	X.X° ± 0.X°
	REBOUND	B"	X.X° ± 0.X°	A"	X.X° ± 0.X°

FIG. 3 FRONT SUSPENSION MOUNTING DIMENSIONING

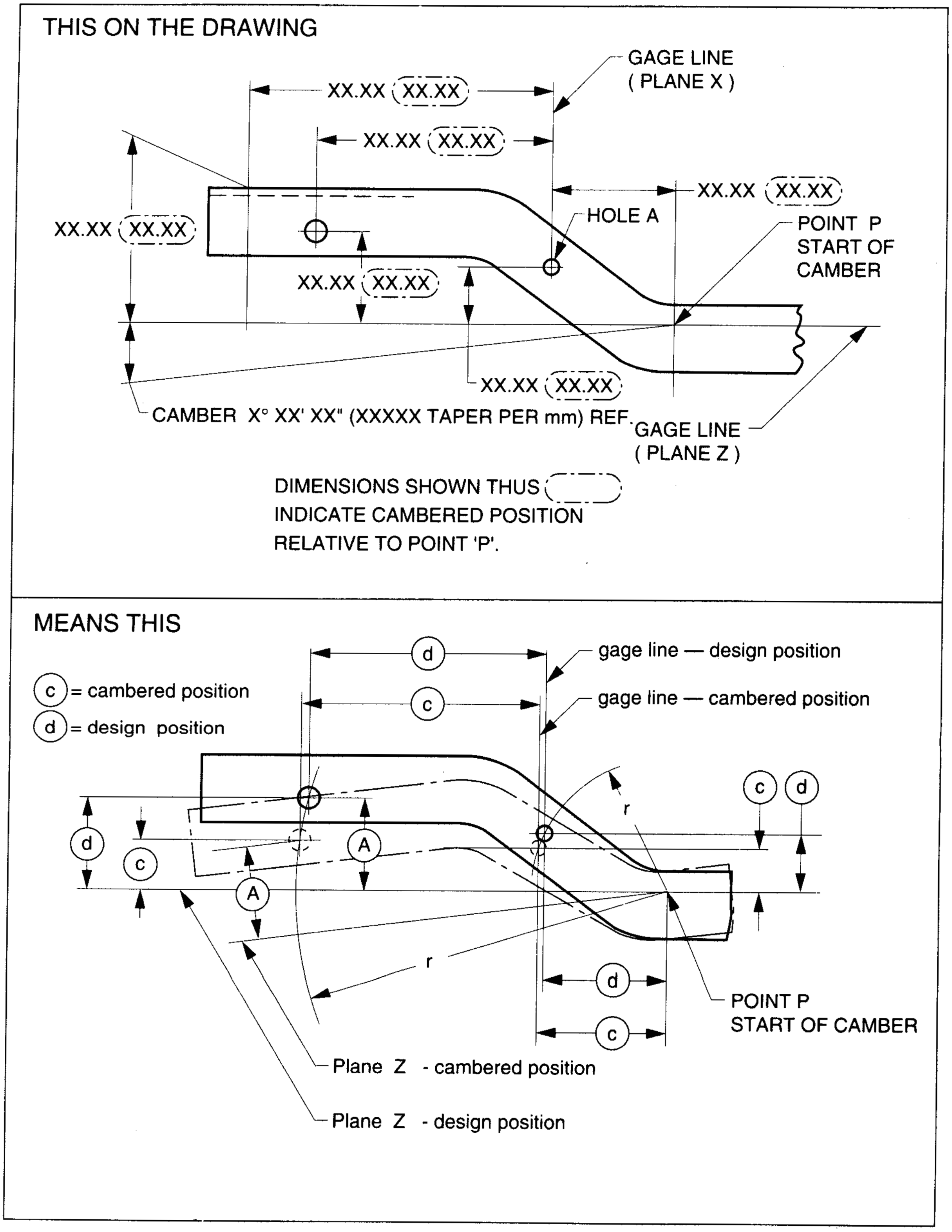


FIG. 4 METHOD FOR SIMPLIFIED SPECIFICATION OF FRAME CAMBER

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