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ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: Bridge Design Manual
Design Criteria For Bridges
Bridge Bearing Selection

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This Engineering Instruction provides criteria for selecting bearings for bridges. In addition, it transmits the following supporting material.

Bridge Bearing Specification (Section 565)

B.D.D. SHEET 83-35, Type S.R. - Steel Rocker Bearing
B.D.D. SHEET 83-36A, Type S.S. - Steel Sliding Bearing
B.D.D. SHEET 84-36B, Type S.S. - Steel Sliding Bearing
B.D.D. SHEET 84-37, Type M.R. - Multi-Rotational Bearing
B.D.D. SHEET 84-38, Type E.P. - Plain Elastomeric Bearing
B.D.D. SHEET 84-39, Type E.L. - Steel Laminated Elastomeric Bearing
B.D.D. SHEET 84-40, Type E.B. - Elastomeric Bearing with External Load Plate
B.D.D. SHEET 84-41, Type E.S. - Elastomeric Sliding Bearing

The specification and available B.D.D. sheets shall be effective with the letting of June 7, 1984.

I. RATIONALE

There are a number of bearing types available for use in bridges. In some situations only one type of bearing may be appropriate, while in other situations the designer may have two or more bearing types from which to choose.

All bearings types to be considered for use with bridges designed by or under the direction of the Department are discussed in this Engineering Instruction. They are described generically and their characteristics noted. The information contained in this instruction, the referenced Bridge Design Data (B.D.D.) Sheets, the bearing specification (Section 565 - Bridge Bearings) and the bearing materials specifications should be consulted by the designer when selecting bearings for each bridge. The selection process must include design considerations, maintenance considerations and cost.

II. WARRANTS

Bridge bearings shall be selected which will perform for the life of the bridge at least cost. The selection shall be made from those listed in Part III of this instruction.

III. BEARING TYPES AND DESCRIPTIONS

A. Type S.R. -Steel Rocker Bearing:

A steel rocker bearing consists of a pinned joint to accommodate rotation and a rocker to accommodate longitudinal movement.

This type of bearing is made from steel.

The major components of a fixed bearing are a sole plate, a cap plate, a web plate and a masonry plate.

The major components of an expansion bearing are the same as for a fixed bearing with the addition of a rocker at the bottom of the web plate which, along with the hinge, permits longitudinal movement.

This type of bearing may only be used on straight steel bridges. It cannot accommodate transverse movement.

Details are shown on BDD SHeet 83-35.

B. Type S.S. - Steel Sliding Bearings:

A steel sliding bearing consists of a rocker to accommodate rotation and a sliding element to accommodate longitudinal movement.

This type of bearing is made from steel with other materials used in the sliding elements, such as bronze, copper or polytetrafluoroethylene (PTFE).

The major components of a fixed bearing are a sole plate, a curved plate and a masonry plate.

The major components of an expansion bearing are the same as for a fixed bearing with the addition of a sliding element which is mechanically fastened to the masonry plate and permits longitudinal movement.

This type of bearing may only be used on straight steel bridges. It cannot accommodate transverse movements.

Details are shown on BDD Sheets 83-36A and 84-36B.

C. Type M.R. - Multi-Rotational Bearing:

A multi-rotational bearing consists of a confined elastomeric element (Pot design) or an unconfined polyether urethane disc (Disc design) to accommodate rotation, and a sliding element to accommodate movement. This type of bearing may be guided, allowing movement in one direction, or non-guided, allowing movement in any direction.

1. Pot design:

The major components of a fixed bearing of this type are a sole plate, a masonry plate and elastomer placed in a steel container, known as a pot. A steel piston effectively seals the open end of the pot with the help of a sealing ring, confining the elastomer. The confined elastomer supports greater loads and behaves similarly to an incompressible fluid, accommodating all rotation.

The major components of an expansion bearing of this type are the same as for a fixed bearing with the addition of the sliding elements. Movement is accommodated by the sliding of polished stainless steel on polytetrafluoroethylene (PTFE). Movement may be restricted by a guide bar or keyway system.

2. Disc design:

The major components of a fixed bearing of this type are a sole plate, a masonry plate, an unconfined polyether urethane disc element and a shear restriction mechanism at the center of the disc. The polyether urethane disc accommodates vertical loads and rotation. The shear restriction mechanism at the center of the disc eliminates shear on the polyether urethane caused by horizontal forces.

The major components of an expansion bearing of this type are the same as for a fixed bearing with the addition of the sliding elements. Movement is accommodated by the sliding of polished stainless steel on polytetrafluoroethylene (PTFE). Movement may be restricted by a guide bar or keyway system.

This type of bearing may be used on all types of bridges because of its multirotational and multitranslational capability.

Details are shown on BDD Sheet 84-37.

D. Type E.P. - Plain Elastomeric Bearing:

A plain elastomeric bearing consists of an elastomer in the shape of a pad to accommodate rotation and longitudinal movement.

This type of bearing is made from an elastomer, which may be polychloroprene or natural rubber.

The major component of a fixed bearing is a plain elastomeric pad. The bearing accommodates rotation by deformation. It should be provided with a hole to allow the use of an anchor pin to preclude longitudinal movement.

The major component of an expansion bearing is the same as for a fixed bearing. The bearing accommodates rotation and longitudinal movement by deformation. It may be provided with an oversize hole and an anchor pin to limit longitudinal movement.

This type of bearing may be used on short, simple span bridges. It provides uniform load transfer, allows beam end rotation and isolates components of the structure from vibration and shock.

Details are shown on BDD SHeet 84-38.

E. Type E.L. - Steel Laminated Elastomeric Bearing:

A steel laminated elastomeric bearing consists of thin layers of elastomer bonded to one or more internal steel plates to accommodate rotation and longitudinal movement.

This type of bearing is made from an elastomer, which may be polychloroprene or natural rubber, and steel plates.

The major components of a fixed bearing are layers of elastomer bonded by vulcanization to all surfaces of internal steel plates. The bearing accommodates rotation by deformation. It should be provided with a hole to allow the use of an anchor pin to preclude longitudinal movement.

The major components of an expansion bearing are the same as for a fixed bearing. The bearing accommodates rotation and longitudinal movement by deformation. It may be provided with oversize hole and an anchor pin to limit longitudinal movement.

This type of bearing may be used on short to medium span structures, with either simple or continuous spans. This bearing provides uniform load transfer, allows beam end rotation and isolates components of the structure from vibration and shock.

Details are shown on BDD Sheet 84-39.

F. Type E.B. - Elastomeric Bearing With External Load Plates:

An elastomeric bearing with an external load plate or plates consists of a plain or steel laminated elastomeric bearing with one or more external steel load plates to accommodate rotation and longitudinal movement.

This type of bearing is made from an elastomer, which may be polychloroprene or natural rubber, and steel plates.

The major components of a fixed bearing are layers of elastomer bonded by vulcanization to all surfaces of internal steel plates, along with one or more external load plates bonded by vulcanization. There should be an effective rubber layer between the bonded load plate and the adjacent internal steel plate. The bearing accommodates rotation by deformation. It should be provided with a hole to allow the use of an anchor pin to preclude longitudinal movement.

The major components of an expansion bearing are the same as for a fixed bearing. The bearing accommodates rotation and longitudinal movement by deformation. It may be provided with an oversize hole and an anchor pin to limit longitudinal movement.

This type of bearing may be used on short to medium, simple and continuous span structures. This bearing provides uniform load transfer, allows beam end rotation and isolates components of the structure from vibration and shock.

Details are shown on BDD Sheet 84-40.

G. Type E.S. - Elastomeric Sliding Bearing:

An elastomeric sliding bearing consists of a plain or laminated elastomeric bearing with an external sliding element to accommodate logitudinal movement.

This type of bearing is made from elastomer, which may be polychloroprene or natural rubber, steel plates, polytetrafluoroethylene (PTFE) and polished stainless steel.

This type of bearing is only used as an expansion bearing. Its major components are layers of elastomer bonded by vulcanization to all surfaces of internal steel plates, along with sliding elements consisting of polished stainless steel on polytetrafluoroethylene (PTFE). The bearing accommodates rotation by deformation. Movement may be restricted by a guide bar or keyway system.

This type of bearing may be used where excessive movement occurs and a steel laminated bearing would not be stable because of restrictive length to height ratios. It provides uniform load transfer, allows beam end rotation and isolates components of the structure from vibration and shock.

Details are shown on BDD Sheet 84-41.

IV. SELECTION CRITERIA

When selecting a bearing, the factors listed below should be considered.

1) Vertical load capacity required
2) Movement capability required
3) Effect of bearing selected on the substructure because of
   a) Longitudinal forces created by bearing friction
   b) Width of cap beam required
4) Life cost of bearing
   a) Initial cost of bearing
   b) Extent, frequency and cost of maintenance required.
5) Aesthetic considerations
6) Unique factors specific to the particular bridge

These factors are discussed below and summarized in TABLE 1.

Factors 1 and 2 must be considered in all cases.

Factor 3 is very important when the bearing is to be used on a high pier. A bearing which minimizes longitudinal forces should be used in this case. A secondary consideration is the area of substructure required to accommodate the bearing. It is desirable to use bearings requiring the smallest plan area in order to minimize substructure size.

Factor 4 includes both the first cost of the bearing, and the cost to maintain it throughout its useful life. First cost prices should be checked at the time the selection is being made by contacting the Special Design Unit of the Structures Division. Maintenance requirements for the various types of bearings range from no maintenance for bearings without sliding surfaces to minimal maintenance for bearings with PTFE and stainless steel sliding surfaces, to frequent maintenance for bearings with steel to steel or steel to copper or bronze sliding surfaces.

Factor 5 is subjective, but it is generally thought that low bearings result in a bridge with a more pleasing appearance than high bearings. Thus, lower bearings should be used unless high bearings are dictated by other factors.

Factor 6 is not expected to be a consideration except on very rare occasions. The use of bearings other than might be selected from review of this criteria must be justified and the reasons for such use clearly supported.

Generally only one type of bearing should be used for each structure. For multi-structure projects it is desirable to minimize the number of bearing types in order to save money.

Generally, there shall be at least one line of fixed bearings on every structure. However, there may be occasions where only fixed bearing is appropriate, such as a very wide bridge. Fixed bearings should generally be placed at the low end of a simple span. For continuous spans the point of fixity should be selected such that superstructure movements are approximately equal on either side of the line of fixed bearings.

Fixed bearings should be used at both ends of steel structures having spans less than 30 ft. and at both ends of concrete structures having spans less than 40 ft.

Tapered elastomeric laminates or pads shall not be used.

The rotational capability of the bearing is important to ensure that moments introduced in the bridge supports are not excessive and that the bearings can sustain the required rotation without lift-off of the girders.

NOTES:

1) THE VALUES SHOWN IN TABLE 1 INDICATE GENERAL LIMITS IN USE. ALL BEARINGS CAN BE DESIGNED FOR HIGHER VALUES.

2) MOVEMENT AND HORIZONTAL FORCE ARE USED IN DESIGNING EXPANSION BEARINGS ONLY. ALL OTHER INFORMATION IS APPLICABLE TO BOTH EXPANSION AND FIXED BEARINGS.

3) THE TYPES OF BEARINGS SHOWN MAY BE USED FOR BOTH SIMPLE AND CONTINUOUS SPANS.

4) "ONE WAY MOVEMENT" IS THE MAXIMUM MOVEMENT (EXPANSION OR CONTRACTION) OF THE SUPERSTRUCTURE, RELATIVE TO ITS LENGTH AT 68°± F.

TABLE 1

TYPE OF BRG.	Vertical Load Recom. Range (Kips)	Movement Capacity One Way (Inches)	Horiz. Force on Substr. (% of Superstr. Dead Load)	Maintenance Requirements	Brg. Height Approx. Range (Inches)	Typical Applications			
						Straight	Curved	Steel	Conc.
S.R.	150 to 600	2.5 to 4.0	3	Maximum	14.25 to 26.25	✓	—	✓	—
S.S.	50 to 300	1.0	15	Maximum	5.0	✓	—	✓	—
M.F.	100 to 4000	No Limit	3 to 5	Minimal	2.5 to 7.0	✓	✓	✓	✓
E.P.	75 to 200	.375	3 to 12	None	.5 to .75	✓	✓	—	✓
E.L.	75 to 300	2.5	3 to 12	None	1.0 to 5.0	✓	✓	—	✓
E.B.	75 to 300	2.5	3 to 12	None	1.0 to 6.0	✓	✓	✓	✓
E.S.	75 to 300	No Limit	3 to 12	Minimal	1.5 to 7.0	✓	✓	✓	—

SECTION 565 - BRIDGE BEARINGS

565-1 DESCRIPTION. The work shall consist of furnishing, placing, and setting bridge bearings at the locations indicated on the plans.

565-1.01 Bearing Types. There are various types of bearings. The specific type required will be indicated on the plans. Bearing types are:

A. Type S.R. - Steel Rocker Bearings. These accomodate rotation by pivoting around a pinned joint. They are fabricated in fixed and expansion versions. The expansion version accommodates longitudinal movement by means of a curved rocker rotating on the bearing surface. Steel rocker bearings do not allow for transverse movement.

B. Type S.S. - Steel Sliding Bearings. These accommodate rotation by means of a rocker. They are fabricated in fixed and expansion versions. The expansion version accommodates longitudinal movement with a sliding element. Steel sliding bearings do not allow for transverse movement.

C. Type M.R. - Multi-Rotational Bearings. These accommodate rotation by the deformation of a confined elastomeric element, or an unconfined urethane disc. Multi-rotational bearings are fabricated in fixed and expansion versions. The expansion version accommodates movement by means of sliding elements. Expansion versions may be guided, allowing movement in only one direction, or non-guided, allowing multi-directional movement.

D. Type E.P. - Plain Elastomeric Bearings. These accommodate rotation by the deformation of a plain elastomeric pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

E. Type E.L. - Steel Laminated Elastomeric Bearings. These accommodate rotation by the deformation of a laminated elastomeric and steel pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

F. Type E.B. - Elastomeric Bearings With External Steel Load Plates. These accommodate rotation by the deformation of a plain or steel laminated elastomeric pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

G. Type E.S. - Elastomeric Sliding Bearings. These accommodate rotation by the deformation of a plain or steel laminated elastomeric pad, and longitudinal movement by means of a sliding interface of stainless steel and polytetrafluoroethylene to accommodate movement. They may be guided, allowing one directional movement, or non-guided, allowing multi-directional movement. The bearings are suited for expansion applications only.

565-2 MATERIALS.

565-2.01 General. Materials shall meet the following requirements:

Plain Elastomeric Bridge Bearings	716-02
Steel Laminated Elastomeric Bridge Bearings	716-04
Disc Design Structural Bridge Bearings	716-06.01
Pot Design Structural Bridge Bearings	716-07.01
Elastomeric Sliding Bridge Bearings	716-08
Concrete Grouting Material	701-05
Anchor Bolts	723-60
Rubber Impregnated Woven Cotten Fabric	728-01
Rubber Impregnated Random Fiber Pad	728-02
Plain Rubber Pad	728-03
Canvas and Dull Orange Primer	728-05
Steel Anchor Dowel	709-01(a)
Paint	708, or SSPC - Paint No. 16

Note a). Steel anchor dowels shall meet the requirements of 709-01 - Bar Reinforcement Grade 60.

565-2.02 Fabrication. Steel components of bridge bearings shall be fabricated in accordance with the applicable requirements of the N.Y.S. Steel Construction Manual (SCM). In addition, component parts of individual bearings shall meet fabrication details as shown in the contract documents.

A. Type S.R. Bearings. These shall conform to the plans and other contract documents.

B. Type S.S. Bearings. These shall conform to the plans and other contract documents.

C. Type M.R. Bearings. These shall conform to the requirements of either 716-06.01 or 716-07.01 as applicable, and other contract documents. When type M.R. bearings are specified the contractor may supply either disc design or pot design bearings. Only one type of bearing shall be supplied for any bridge.

D. Type E.P. Bearings. These shall conform to the requirements of 716-02 and other contract documents.

E. Type E.L. Bearings. These shall conform to the requirements of 716-04 and other contract documents.

F. Type E.B. Bearings. These shall conform to the requirements of 716-02 or 716-04 and other contract documents.

G. Type E.S. Bearings. These shall conform to the requirements of 716-08 and other contract documents.

565-2.03 Drawings. Shop drawings will be required for all bearings. They shall be furnished in accordance with the SCM, Section 2.

565-2.04 Protective Coatings.

A. Machine finished surfaces in sliding contact, including pins, pin holes, surfaces in sockets at the top of rocker bearings, and bronze or copper plates in sliding contact shall receive one coat of automotive grease as soon as machining is complete. None of these surfaces shall be painted.

B. Stainless steel and poytetrafluoroethylene surfaces shall not be painted or otherwise coated.

C. Metal to metal surfaces to be field welded shall be given a coat of clear lacquer or other protective coating approved by the Engineer, or Inspector, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding. Painting, if required, will be done only after the completion of welding. Surfaces to be painted shall be primed and painted in accordance with 565-2.04E.

D. Bearings attached to unpainted steel superstructures shall not be painted, unless otherwise required.

E. All other metal surfaces shall be painted the identical finish coat color as the structural steel to which the bearing is attached.
Primer may be 708-03, 708-09, or a coal tar epoxy system meeting the requirements of SSPC-Paint 16. Metal primed with 708-03, or 708-09 shall be painted three coats of paint in accordance with 740-01.
Metal primed with the coal tar epoxy system shall be primed a first coat at a minimum wet film thickness of 10 mils. and will require only a finish coat atop the primer. The finish coat shall be applied in accordance with 740-01.

565-2.05 Shipping. Each bearing shall be shipped as an assembled unit, except for elastomeric bearings. Elastomeric bearings may be shipped in packages containing more than one bearing, provided the package can be handled with normal construction equipment. Bearings shall be packaged in such a manner to protect all rotating and sliding surfaces from the intrusion of outside material.

Type M.R. Bearings shall be shipped precompressed to 500 psi.

565.-3 CONSTRUCTION DETAILS.

565 -3.01 Concrete Bearing Surface Elevations

A. General. The elevation of the concrete bearing surface for all types of bearings, except Type MR bearings, shall be as given on the plans.

B. Type M.R. Bearings. The elevation of the concrete bearing surface may vary from that given on the plans depending on the vertical dimension of the bearing supplied. The contractor shall notify the Engineer of all required elevation changes. Changes to the roadway profile will not be allowed, and all elevation adjustments necessary to maintain the profile shall be made to the concrete bearing surfaces. All adjustments will be made at no additional cost to the State.

565-3.02 CONCRETE BEARING SURFACE PREPARATION. No bearing shall be placed upon a concrete bearing surface which is deformed, irregular, or poorly finished. The entire bearing surface area shall be floated and troweled. If there are concrete pedestals, the Contractor may elect to leave the entire pedestal area 1/4 inch high and bush hammer, or otherwise finish, the entire area to the exact elevations indicated on the plans. If the bearing is placed directly on the bridge seat the concrete shall be placed to its proper elevation initially.

565-3.03 SETTING ANCHOR BOLTS Anchor bolts shall be set as shown on the plans unless changes are permitted by the D.C.E.S. If anchor bolts are cast in substructure concrete, templates, or other suitable means, shall be used to keep the bolts in correct vertical and horizontal position during concrete placement.
If the contractor elects to drill the finished, cured concrete in order to set the anchor bolts, he shall position the reinforcing steel prior to casting the concrete so that it will not be damaged during drilling. Anchor bolt holes shall be drilled to a diameter one inch greater than the diameter of the anchor bolt. The bolts shall be set immediately after the holes are drilled using the following procedure:

A. Clean holes.

B. Place bolts in holes to verify proper fit and placement.

C. Remove bolts.

D. Brush sides of holes with concrete grout material.

E. Fill hole to about two-thirds depth with concrete grouting material.

F. Insert bolts, using uniform, even pressure, or light blows with hammer, until the required penetration depth is reached.

G. Add concrete grouting material as required to fill the hole to the top, or remove excess material.

If anchor bolts are to be placed in pipe sleeves, the sleeves shall be filled with sand and sealed at the top with bituminous material prior to concrete placement. The sleeves shall remain sealed until the time of anchor bolt installation. At this time the sleeves shall be completely cleaned-out and the anchor bolts installed using procedures E through G.

565-3.04 VERTICAL LOAD TRANSMITTING DEVICE (BEARING PAD) INSTALLATION. Bearing pads placed between concrete, or other masonry, and steel masonry plates shall be located to correct alignment and elevation, and placed at the time of masonry plate installation. Bearing pads shall conform to 728-01, 728-02, 728-03, or 728-05 at the contractor's option. Each bearing pad shall be the same size in plan as the masonry plate it supports. Holes to accommodate anchor bolts shall be cleanly and accurately cut prior to bearing pad placement.

565-3.05 BEARING INSTALLATION AND ALIGNMENT.

A. Type S.R. Bearings.

1. General

a. The centerline of sole plates or other fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.

b. The bearing shall be cleaned and regreased with automotive grease at the time of installation.

2. Fixed. No additional requirements apply.

3. Expansion. These may vary from perfect alignment. Therefore expansion bearings shall be set in accordance with the following:

a. The axes shall be substantially vertical under full dead load at an ambient temperature of 68F.

b. The maximum variation from perfect alignment is a function of the bearing height. The bearing height is the distance between the upper and lower contact surfaces of the movable portion of the bearing.

For bearings with a height of twenty(20) inches or less, the maximum variation from perfect alignment, taking into account the effect of temperature and load at the time of measurement, shall be calculated by the following formula:

$$M = \pm \left(1/2" + \frac{L}{14000}\right)$$

where "M" = maximum variation from perfect alignment measured as the horizontal distance between the centerline of the cap plate and the centerline of the masonry plate and "L" = total expansion length in inches between the centerline of the movable bearing being considered and the centerline of the fixed bearing, from which motion must progress. Such variations shall not exceed one inch offset, or a five(5) degree rotation of the movable portion of the bearings from the required alignment, whichever is less.

The maximum variation of all bearings having a height exceeding twenty(20) inches shall be approved on an individual basis by the D.C.E.S.

c. No bearing adjustments shall be made until the complete structural slab has been in place for at least seven curing days.

B. Type S.S. Bearing.

1. General.
   a. The centerline of sole plates or other fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.
   b. The bearing shall be cleaned and regreased with automotive grease at the time of installation.

2. Fixed. No additional requirements apply.

3. Expansion. These may vary from perfect alignment. Therefore expansion bearings shall be set in accordance with the following:
   a. The sliding plate shall be centered on the masonry plate under full dead load at an ambient temperature of 68°F.

b. The maximum variation from perfect alignment between the centerlines of the fixed and movable portions of the bearing device, taking into account the effect of temperature and load at the time of measurement, shall not exceed plus or minus 1/2 inch longitudinally. This variation shall be measured as the horizontal distance between the centerline of the sliding plate and the centerline of the masonry plate. The movable portion of the bearing device shall be fully supported by the fixed portion under all temperature and loading conditions.

c. No bearing adjustments shall be made until the complete structural slab has been in place for at least seven curing days.

C. Type M.R. Bearings.

1. General. The centerline of sole plates or other fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.

2. Fixed. No additional requirements apply.

3. Expansion. These may vary from perfect alignment. Therefore expansion bearings shall be set in accordance with the following:

a. The sliding plate shall be centered on the masonry plate under full dead load at an ambient temperature of 68°F.

b. The maximum variation from perfect alignment between the centerline of the fixed and movable portions of the bearing device, taking into account the effects of temperature and load at the time of measurement, shall not exceed plus or minus one inch longitudinally unless otherwise indicated on the plans. This variation shall be measured as the horizontal distance between the centerline of the sliding plate and the centerline of the masonry plate.

c. No bearing adjustments shall be made until the complete structural slab has been in place for at least seven curing days.

D. Type E.P. Bearings.

1. General.
   a. These bearings are designed to function properly provided that minimum distortion occurs along the beam axis under full dead load at an ambient temperature of 68°F. Therefore, beams shall be erected only if the ambient temperature is within the temperature range given on the plans. If no range is given on the plans, the temperature range shall be 40-90°F inclusive.
   b. For prestressed concrete superstructures, the bearing shall be anchored to establish the fixed end of the bridge as soon as possible after stringer erection. For adjacent prestressed box beams, or prestressed slab superstructures, the anchorage shall be completed prior to filling the shear keys. The method of anchorage shall be in accordance with the details shown on the plans. Anchor dowel holes shall be core drilled to the nominal size and depth and at the locations required by the plans. In lieu of core drilling, the contractor may submit an installation procedure that incorporates the use of either preset anchor bolts or pipe sleeves to the D.C.E.S. for approval. Prior to placing the anchor dowel, the hole shall be inspected and approved for filling by the Engineer. Fill material shall be in accordance with the details on the plans.

2. Fixed. No additional requirements apply.

3. Expansion. These may vary from perfect alignment. The maximum variation from perfect alignment under full dead load shall not exceed the value shown on the plans. This variation shall be measured as the horizontal distance between the centerline of the highest elastomer surface and the centerline of the lowest elastomer surface.

E. Type E.L. Bearings. The provisions of 565-3.05D shall apply.

F. Type E.B. Bearings.

1. General.
   a. The centerline of sole plates or other fixed portions of bearing assemblies, attached to steel stringers, shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.

b. These bearings are designed to function properly provided that minimum distortion occurs along the beam axis under full dead load at an ambient temperature of 68°F. Therefore, beams shall be erected only if the ambient temperature is within the temperature range given on the plans. If no range is given on the plans, the temperature range shall be 40-90°F inclusive.

2. Fixed. No additional requirements shall apply.

3. Expansion. These may vary from perfect alignment. The maximum variation from perfect alignment under full dead load shall not exceed the value shown on the plans. This variation shall be measured as the horizontal distance between the centerline of the highest elastomer surface and the centerline of the lowest elastomer surface.

G. Type E.S. Bearings.

1. General.

a. The centerline of sole plates or other fixed portions of bearing assemblies attached to steel stringers shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.

b. The maximum variation from perfect alignment between the centerlines of the fixed and movable portions of the bearing device, taking into account the effect of temperature and load at the time of measurement, shall not exceed plus or minus one half inch longitudinally unless otherwise indicated on the plans. This variation shall be measured as the horizontal distance between the centerline of the sliding plate and the centerline of the elastomeric portion of the bearing.

c. No bearing adjustments shall be made until the complete structural slab has been in place for at least seven curing days.

565-3.06 WELDING

A. Type S.R. Bearings. Bearings shall be welded permanently to the structural steel only after all necessary adjustments have been made. All welding shall be done in accordance with requirements of the SCM.

B. Type S.S. Bearings. The requirements of subsection 565-3.06A shall apply.

C. Type M.R. Bearings. The requirments of subsection 565-3.06A shall apply except that during field welding operations the temperature of the steel adjacent to the rotational element shall not exceed 200 degrees F. Temperature shall be controlled by welding procedures and monitored using temperature indicating crayons, or other devices. Procedures, crayons, and other devices shall be acceptable to the Engineer. If the temperature limit is exceeded, the D.C.E.S. and the Director, Materials Bureau shall be immediately notified. The D.C.E.S. will provide the proper repair procedure, which may include complete replacement of the bearing. All repair work shall be done at no additional cost to the State.

D. Type E.B. Bearings. The requirements of 565-3.06A and 565-3.06C shall apply.

E. Type E.S. Bearings. The requirements of 565-3.06A and 565-3.06C shall apply.

565-3.07 GROUTING ANCHOR BOLT HOLES. All slotted anchor bolt holes in masonry plates shall be filled with concrete grouting material to the top edge of the hole. All excess grout material shall be cleaned from the bearing surfaces in a manner satisfactory to the Engineer.
Slotted anchor bolt holes in fixed bearings may be filled any time subsequent to stringer placement. Slotted holes in expansion bearings shall be filled only after all necessary bearing adjustments have been made.

565-3.08 FINAL VERIFICATION. Prior to final acceptance of the bridge, the Engineer will verify that all necessary adjustments have been made; that all steel bearings, or load plates, are permanently welded to the superstructure steel; that all slotted holes are completely filled with grout; that all anchor bolts are firmly tightened; and that all other work required to make the bearings completely functional has been completed.

565-4. METHOD OF MEASUREMENT. Measurement will be taken as each bearing installed.

565-5. BASIS OF PAYMENT. The unit price bid for each bearing shall include the cost of all labor, materials, equipment and adjustment necessary to complete the work. All material between the bottom of the superstructure including sole plates, and the top of the substructure shall be included in the price bid for this item.

565-5.01 Progress Payments.

A. Type S.R. Bearings.
1. Eighty percent of the quantity will be paid for after the bearing is installed.
2. The remainder of the quantity will be paid for after the bearing is aligned as required.

B. Type S.S. Hearings. The requirements of 565-5.01A shall apply.

C. Type M.R. Bearings. The requirements of 565-5.01A shall apply.

D. Type E.S. Bearings. The requirements of 565-5.01A shall apply.

565-5.02 Payment

Payment will be made under:

Item No.	Item	Pay Unit
565.11	Type S.R. Expansion Bearings (Various Load Ranges)	Each
565.12	Type S.R. Fixed Bearings (Various Load Ranges)	Each
565.13	Type S.S. Expansion Bearings (Various Load Ranges)	Each
565.14	Type S.S. Fixed Bearings (Various Load Ranges)	Each
565.15	Type M.R. Guided Expansion Bearings (Various Load Ranges)	Each
565.16	Type M.R. Non-Guided Expansion Bearings (Various Load Ranges)	Each
565.17	Type M.R. Fixed Bearings (Various Load Ranges)	Each
565.18	Type E.P. Bearings (Various Load Ranges)	Each
565.19	Type E.L. Bearings (Various Load Ranges)	Each
565.20	Type E.B. Bearings (Various Load Ranges)	Each
565.21	Type E.S. Guided Bearings (Various Load Ranges)	Each
565.22	Types E.S. Non-Guided Bearings (Various Load Ranges)	Each

716-08 - ELASTOMERIC SLIDING BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for elastomeric sliding bridge bearings. Elastomeric sliding bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage, where applicable, of structural members.

GENERAL. Elastomeric sliding bridge bearings shall consist of a plain or steel laminated elastomeric element bonded to a lower steel bearing plate. To allow movement, the upper surface of the element shall be faced with a steel backed, polytetrafluorethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the top steel bearing plate shall be faced with polished stainless steel.

Elastomeric sliding bridge bearings shall be supplied as guided expansion bearings or non-guided expansion bearings, as designated by the Contract Documents.

1. GUIDED EXPANSION BEARINGS

   Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. To restrict transverse movement, a guide bar or keyway system shall be used. If required, the guide bar or keyway system shall be faced with strips of PTFE.

2. NON-GUIDED EXPANSION BEARINGS

   Non-Guided Expansion Bearings shall allow rotation, longitudinal and transverse movement in the bearing plane.

MATERIAL REQUIREMENTS

All materials shall be new and unused, with no reclaimed material incorporated in the finished bearing.

1. Elastomeric Element. The elastomeric element used in the construction of these bearings shall conform to the requirements of Section 716-02, Plain Elastomeric Bridge Bearings or Section 716-04, Steel Laminated Elastomeric Bridge Bearings.

2. Steel Backing Plate and External Load Bearing Plates. Steel backing plate for PTFE sheet, and external load bearing plates shall conform to the requirements of ASTM A36; A167, Type 304; A240, Type 304; or A588 and the applicable provisions of the SCM, unless otherwise provided for in the contract plans.

External load bearing plates fabricated from ASTM A36 steel shall be protected from rust until all exposed surfaces can be field painted. Any rust inhibitor used shall be removed from all surfaces to be welded, prior to welding.

Steel backing plate that is fabricated from ASTM A36 steel, and both backing plates and external load bearing plates that are fabricated from ASTM A167, A240 and A588 steels shall not be painted or coated with rust inhibitors.

3. Stainless Steel. Stainless steel shall conform to the requirements of ASTM A167, or A240, Types 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8, bright mirror finish (less than 10 micro-inches root mean square). The minimum thickness of the stainless steel shall be 0.050 inches.

4. Polytetrafluoroethylene (PTFE) Sheet. Polytetrafluoroethylene (PTFE) sheet shall be manufactured from pure virgin (not reprocessed) unfilled TFE resin; or from TFE resin uniformly blended with either 15% glass fiber or 25% carbon (maximum filler, percent by weight).

PTFE sheet shall be bonded to or recessed into its steel backing plate. Bonded PTFE sheet shall be etched on its bonding side, and shall have a minimum thickness of 1/16 inch. Recessed PTFE sheet shall have a minimum thickness of 1/8 inch and be recessed for at least one-half its thickness into its steel substrate. The mating sliding surface of filled PTFE sheet in contact with stainless steel shall be polished or burnished to insure smooth and low friction movement of the bearing.

Finished PTFE sheet and strip shall be resistant to all acides, alkalis and petroleum products, stable at temperatures from -360°F to +500°F, non-flammable, non-absorbing of water, and shall conform to the following physical requirements:

		REQUIREMENTS		
Physical Property	ASTM Test Method	Unfilled	Filled 15 Glass	25% Carbon
Ultimate Tensile Strength, psi, min.	D638	2800	2500	1300
Ultimate Elongation, &, min.	D638	200	150	75
Specific Gravity, min.	D792	2.13	2.18	2.05

FABRICATION DETAILS. The finish of the mold used to produce the bearing elements shall conform to good machine shop practice. Every bearing shall have the Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The elastomeric element shall be fabricated in accordance with the requirements of Sections 716-02 and 716-04. External lower steel bearing plates and steel backing plates for PTFE sheet shall be factory bonded, by vulcanization, to the elastomeric element during the primary molding process.

The PTFE sheet shall be bonded to its grit blasted steel backing plate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its backing plate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

Stainless steel sheet used for sliding surfaces on upper steel bearing plates fabricated from ASTM A36 or A588 steel shall be attached by a full perimeter, continuous weld.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.010". Out-of-flatness greater than 0.010" on any plate shall be cause for rejection. The bottom surfaces of lower external load plates (masonry plate) designed to rest on bearing pads shall not exceed an out-of-flatness value of 0.0625" (1/16"). Oxygen cut surfaces shall not exceed a surface roughness value of 1000 micro-inches, as defined by ANSI B46.1. Repair, when necessary, shall conform to the requirements of the SCM.

Unless otherwise approved by the D.C.E.S., all welding shall conform to and all welders shall be qualified in accordance with the requirements of the SCM.

Gross bearing dimensions shall have a tolerance of 0+1/8".

PERFORMANCE CHARACTERISTICS

1. Compressive Strain. The compressive strain of an assembled bearing shall not exceed 5.0% of the effective rubber thickness of the elastomeric element at a compressive load of 500 psi or 8.0% of the effective rubber thickness at a compressive load of 800 psi. When bearings are designed for loading stresses higher than 800 psi, the compression strain shall not exceed 8.0% of the effective rubber thickness at the higher stress. The bearing and ambient temperature shall be 75° +10°F at the time of testing.

2. Compressive Load. Assembled bearings shall be tested in compression by applying a load corresponding to 150% of the design dead plus live load capacity.

   The compressive load shall be maintained for five minutes and the test results evaluated as follows:

   a. The bearing shall be visually examined both during and after the test. Any visual defects shall be cause for rejection.

   b. Non-uniform compression deflection at 150% compressive load will be cause for rejection. Deflection will be measured by dial indicators, at 4 locations 90° apart, on the perimeter of the bearing.

3. Sliding Co-efficient of Friction. For all guided and non-guided elastomeric sliding bridge bearings, the sliding co-efficients of friction shall be measured at the bearing's design capacity, on the fifth and fiftieth cycles, at a sliding speed of 1 inch per minute.

   The sliding co-efficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divded by the bearing's design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

   The test results will be evaluated as follows:

   a. The measured sliding co-efficients of friction shall not exceed 75% of the maximum design co-efficient of friction.

   b. The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged bearing components) shall be cause for rejection.

DRAWINGS. The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the SCM, for approval by the Deputy Chief Engineer (Structures) prior to the start of fabrication. In addition, the manufacturer shall note the following on the shop drawings.

1. The total quantity of each kind of elastomeric sliding bearing required; i.e. guided or non-guided, grouped according to size and design capacities.

2. The shape factor, effective rubber thickness, typical laminate thickness, compressive area, and length to height ratio of the elastomeric element. Computations shall be as defined in Section 716-04.

3. The maximum design co-efficient of friction as noted on the Contract Plans.

4. The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler.

5. The type(s) of steel(s) to be used.

6. If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of the SCM shall be clearly described and detailed.

7. The location of the fabrication plant.

8. The Manufacturer's name and the name of his representative who will be responsible for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty(30) days prior to the start of bearing fabrication. This notification shall include all of the information required by numbers 1 through 8 above. A copy of this notification shall be sent to the Deputy Chief Engineer (Structures).

SAMPLING AND TESTING. The manufacturer shall furnish the required number of samples to perform tests as required. A minimum of thirty(30) days shall be allowed for the Department's inspection, sampling and testing of bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

Bearings with tapered sole plates which are selected for testing by the Materials Bureau, shall be delivered to the test site accompanied by a single unattached matching beveled plate. This plate shall be made of the same material and be the same size and thickness as the tapered sole plate. Additionally, the single beveled plate shall be so constructed that when placed in contact with the tapered sole plate the two shall form a single body, rectangular in shape and uniform in thickness.

The Department's representative shall select, at random, the required sample bearing(s) from completed lots of bearings, and samples of the elastomer and PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

1. Performance Characteristics for Bearings Less Than 650 Square Inches. Bearings with a plan area of less than 650 square inches shall be tested for performance characteristics by the Materials Bureau, Albany, New York. The Contractor shall assume the responsibility and cost of transporting the required bearings from the place of manufacture to Albany and return.

   The sampling rate shall be one per every five in each size category, per project per production run, a minimium of three bearings. All bearings shall be returned to the Contractor.

   The testing of the samples shall be as follows:

TEST	SAMPLES TESTED
Compressive Strain	All
Compressive Load	All (Note 1)
Sliding Co-efficient of Friction	One set of samples per project per size, per production run (1 set equals 2 bearings)
Physical Properties of Elastomeric Element	One 10"x15" (3/8" min., thickness) sheet of elastomeric material per project, per production run (Note 2)
Physical Properties of PTFE Sheet	One 10"x15" sheet of PTFE material per project, per production run. (Note 2).

2. Performance Characteristics for Bearings Greater Than 650 Square Inches. Bearings with a plan area greater than 650 square inches shall be tested by an outside laboratory approved by the Materials Bureau. The Department shall assume the cost of testing. Transportation and scheduling costs shall be the responsibility of the Contractor.

The sampling rate shall be one per every five in each size category, per project per production run a minimum of two bearings. All bearings shall be returned to the Contractor.

The testing of these samples shall be as follows:

TEST	SAMPLES TESTED
Compressive Strain	All
Compressive Load	All
Sliding Co-efficient of Friction	One set of samples per project, per size, per production run. (1 set equals 2 bearings).
Physical Properties of Elastomeric Elements	One 10"x15" (3/8", min. thickness) sheet of elastomeric material per project, per production run (Note 3).
Physical Properties of PTFE Sheet	One 10"x15" sheet of PTFE material per project per production run (Note 3).

NOTE 1: Production bearings of such size that cannot be tested by the Materials Bureau at 150% design capacity for compressive load shall be tested at their actual design capacity.

Note 2: Single sheets of elastomeric and PTFE material from which the bearing has been fabricated shall be submitted to the Materials Bureau for test. All submitted sample sheets shall be certified by the Manufacturer as having been taken from the same batch of material as was used in the actual production bearings.

Note 3: The Materials Bureau will perform this testing. At the time of inspection, single sheets of elastomeric and PTFE sheets from which the bearing has been fabricated shall be submitted by the Department's representative. All submitted sample sheets shall be certified by the Manufacturer as having been taken from the same batch of material as was used in the actual production bearings.

BASIS OF ACCEPTANCE: Bearings shall be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

716-06.01 DISC-DESIGN STRUCTURAL BRIDGE BEARINGS

SCOPE. This specification covers the material requirements for disc-design structural bridge bearings. Bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.

GENERAL. Disc-design structural bridge bearings shall consist of a polyether urethane structural element (disc) confined by upper and lower steel bearing plates. The bearing shall be equipped with a shear restriction mechanism to prevent movement of the disc.

Disc-design structural bridge bearings shall be supplied as fixed bearings; guided expansion bearings; and non-guided expansion bearings as designated by the Contract Documents.

1. Fixed Bearings. Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane.

2. Guided Expansion Bearings. Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. To allow longitudinal movement, the upper steel bearing plate shall be faced with polytetrafluorethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel top bearing plate shall be faced with polished stainless steel. To restrict transverse movement, either a guide bar or keyway system shall be used. If required, the guide bar or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.

3. Non-Guided Expansion Bearings. Non-guided expansion bearings shall allow rotation, longitudinal, and transverse movement in the bearing plane. To allow longitudinal and transverse movement, the upper steel bearing plate shall be faced with polytetrafluorethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel top bearing plate shall be faced with polished stainless steel.

MATERIAL REQUIREMENTS. All materials shall be new and unused, with no reclaimed material incorporated in the finished bearing.

Polyether Urethane Structural Element. The polyether urethane structural element used in the construction of disc-design bearings shall be molded from a polyether urethane compound. The physical properties of the polyether urethane shall conform to the following requirements:

PHYSICAL PROPERTY	ASTM Test Method	REQUIREMENTS Min.	Max.
Hardness, Type D durometer	D2240	46	50
Tensile Stress, psi	D412		
At 100% elongation		1500	-
At 300% elongation		2800	-
Tensile Strength, psi	D412	4000	-
Ultimate Elongation, %	D412	350	-
Compression Set 22 hrs. at 158°F, %	D395	-	40

Steel. - All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual.

Stainless Steel. - Stainless steel shall conform to the requirements of ASTM A-167, or ASTM A-240, Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8, bright mirror finish (less than 10 micro-inches root mean square). The minimum thickness of the stainless steel shall be 0.050 inches.

Polytetrafluorethylene Sheet and Strip. - polytetrafluorethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not reprocessed) unfilled TFE resin; or from TFE resin uniformly blended with either 15% glass fiber or 25% carbon (maximum filler, percent by weight).

PTFE sheet shall be bonded to or recessed into its steel substrate. Bonded PTFE sheet shall be etched on its bonding side, and shall have a minimum thickness of 1/16 inch. Recessed PTFE sheet shall have a minimum thickness of 1/8 inch and be recessed for at least one-half its thickness into its steel substrate. The surface of filled PTFE sheet in contact with stainless steel shall be polished or burnished to insure smooth and low friction movement of the bearing.

Finished PTFE sheet and strip shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from -360°F to +500°F, non-flammable, non-absorbing of water, and shall conform to the following physical requirements.

Physical Property	ASTM Test Method	REQUIREMENTS Unfilled	Filled 15% Glass	Filled 25% Carbon
Ultimate Tensile Strength, psi, min.	D638	2800	2000	1300
Ultimate Elongation, %, min.	D638	200	150	75
Specific Gravity, min.	D792	2.13	2.18	2.05

FABRICATION DETAILS. The finish of the mold used to produce the bearing elements shall conform to good machine shop practice. Every bearing shall have the Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The PTFE sheet shall be bonded to its grit blasted steel substrate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its steel substrate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded, shall be shop painted with one coat of coal-tar epoxy. Coal-tar epoxy paint shall meet the requirements of SSPC Paint Specification No. 16, and be applied at a minimum wet film thickness of 10 mils. Prior to painting, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding. No painting will be done to these surfaces prior to the completion of welding.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.010". Out-of-flatness greater than 0.010" on any plate shall be cause for rejection. The bottom surfaces of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 0.0625" (1/16"). Oxygen cut surfaces shall not exceed a surface roughness value of 1000 micro-inches, as defined by ANSI B46.1. Repair, when necessary, shall conform to the requirements of the New York State Steel Construction Manual.

Unless otherwise approved by the D.C.E.S., all welding shall conform to, and all welders shall be qualified in accordance with the requirements of the New York State Steel Construction Manual.

Gross bearing dimensions shall have a tolerance of -0, +1/8".

PERFORMANCE CHARACTERISTICS.

Compression Strain. The compression stress is based on the net plan area of the rotational element using the total overall diameter. The compression strain is measured as a percentage of the original thickness of the rotational element.

A load equal to 150% of the bearing's design capacity shall first be applied to seat the bearing components. The 150% load shall then be gradually reduced, over a time period of 30 to 90 seconds, to a pre-load equal to 3% of the bearing's design capacity. Each compression strain shall be recorded relative to the initial 3% pre-load deflection, one minute after the desired stress level has been reached, by dial indicators, at four locations 90° apart on the perimeter of the bearing.

The test results will be evaluated as follows:

1. The bearing will be visually examined both during and after the test. Any resultant visual defects (such as extruded elastomer, damaged seals, or cracked steel) shall be cause for rejection.

2. Non-uniform compression deflections at a desired stress level shall be cause for rejection.

3. The compression strain of each bearing shall conform to the following requirements:

Compression Stress P.S.I.	Compression Strain, % Min.	Max.
1000	3.0	5.0
2000	5.5	8.5
3000	7.5	11.0
3500	8.1	12.1

Sliding Coefficient of Friction. For all guided and non-guided expansion disc-design bearings, the sliding coefficients of friction shall be measured at the bearing's design capacity, on the fifth and fiftieth cycles, at a sliding speed of 1 inch per minute.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

The test results will be evaluated as follows:

1. The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction.

2. The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged components) shall be cause for rejection.

Rotation. For all disc-design bearings, the polyether urethane element shall be capable of maintaining its initial uniform contact with the steel bearing plates throughout a rotation range of 0.02 radians (1.1456°), under a compressive load equal to 150% of the design capacity of the bearing.

The test results will be evaluated as follows:

1. The bearing will be visually examined both during and after the test. Any resultant visual defects shall be cause for rejection.

2. Continuous and uniform contact between the polyether urethane element and bearing plates, and between the sliding steel top and upper bearing plates shall be maintained for the duration of the test. Any observed "lift-off" shall be cause for rejection.

DRAWINGS. The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the New York State Steel Construction Manual, for approval by the Deputy Chief Engineer (Structures) prior to the start of fabrication.

In addition to the above requirements, the Manufacturer shall note the following on the shop drawings.

1. The total quantity of each kind of disc-design bearing required, i.e. fixed, guided expansion, or non-guided expansion, grouped first according to type (load range) and then by actual design capacity.

2. The thickness and plan area of the polyether urethane structural elements required.

3. The maximum design coefficient of friction as noted on the Contract Plans.

4. The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler.

5. The type(s) of steel(s) to be used.

6. If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of the New York State Steel Construction Manual shall be clearly described and detailed.

7. The location of the fabrication plant.

8. The Manufacturer's name and the name of his representative who will be responsible for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of bearing fabrication. This notification shall include all of the information required by numbers 1 through 8 above. A copy of this notification shall be sent to the Deputy Chief Engineer (Structures).

SAMPLING AND TESTING.

Lot Size. Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria:

1. A lot shall not exceed a single contract or project quantity;
2. A lot shall not exceed 25 bearings.
3. A lot shall consist of those bearings that can be manufactured with polyether urethane rotation elements from one batch of polyether urethane material. The weight of one batch shall not exceed 450 pounds.
4. A lot shall consist of those bearings of the same type, regardless of load capacity. Bearing types shall be fixed type bearings or expansion type bearings. Guided and non-guided expansion bearings will be considered a single type.

Sampling and Testing Requirements. The manufacturer shall furnish the required number of samples to perform testing in accordance with Table 1.

A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of production bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

Bearings with tapered sole plates which are selected for testing by the Materials Bureau, shall be delivered to the test site accompanied by a single unattached matching beveled plate. This plate shall be made of the same material and be the same size and thickness as the tapered plate. Additionally the single beveled plate shall be so constructed that when placed in contact with the tapered sole plate the two shall form a single body, rectangular in shape and uniform in thickness.

The manufacturer shall select, at random, the required sample bearing(s) from completed lots of bearings for testing by the manufacturer. He shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling and acceptance consideration.

The Department's representative shall select, at random, the required sample bearing(s) from completed lots of bearings, and samples of the polyether urethane and PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

The Contractor shall assume the cost of transporting all samples from the place of manufacture to the Materials Bureau and return, or, if applicable, to the project site.

TABLE 1 SAMPLING AND TESTING REQUIREMENTS

Test	Performed By	Samples Required
Rotation	Manufacturer	One production bearing per lot (Note 1)
Coefficient of Friction	Manufacturer	One production bearing per lot (Note 1)
Compression Strain	Materials Bureau	a) For bearings with load capacities less than 600,000 lbs.; three production bearings per lot. b) For bearings with load capacities greater than 600,000 lbs.; three production bearings per lot, tested by an outside laboratory approved by the Materials Bureau (Note 2).
Physical Properties of Polyether Urethane Rotational Element (except compression set)	Materials Bureau	One 10"X15" sheet of polyether urethane material (thickness of 0.063" to 0.120") per lot. (Note 3)
Compression Set of Polyether Urethane Rotational Element	Materials Bureau	One 4"X4" sheet of polyether urethane material, molded or cut to the thickness requirements of ASTM D395, Method B. (Note 4)
Physical Properties of PTFE Sheet	Materials Bureau	One 10"X15" sheet of PTFE material per lot (Note 5)

NOTE 1: Sample production bearings of such size that cannot be tested by the manufacturer at 150% design capacity for rotation shall be tested at actual design capacity. Bearings which are tested at actual design capacity will be tested at that capacity because it is not possible, or not practical in the Department's opinion to test them at a higher capacity. Therefore, bearings tested at 150% design capacity which are rejected, will not be retested below

150% design capacity for the purpose of rendering such bearings acceptable. Sample production bearings that cannot be tested by the Manufacturer at their actual design capacity for rotation and/or friction shall be tested by an outside laboratory selected by the Materials Bureau. The Manufacturer shall assume the cost of this testing and submit the certified test results to the Materials Bureau.

NOTE 2: The Department shall assume the cost of this testing. The Contractor shall be responsible for transportation scheduling and costs. All bearings shall be made available for return to the Contractor.

NOTE 3: All submitted sample sheets of polyether urethane material shall be certified by the bearing manufacturer as having been taken from the same batch of polyether urethane material as was used in the actual production bearings.

NOTE 4: The manufacturer shall have the option of supplying four (4) die cut specimens in accordance with ASTM D-395, Method B. All submitted specimens of polyether urethane material shall be certified by the bearing manufacturer as having been taken from the same batch of polyether urethane material as was used in the actual production bearings.

NOTE 5: Single sheets of PTFE Material from which the bearing has been fabricated may be submitted to the Materials Bureau for consideration of multiple lot acceptance, provided that the thickness of the material does not vary from lot to lot. All submitted sample sheets shall be certified by the bearing manufacturer as having been taken from the same batch of PTFE material as was used in the actual production bearings.

BASIS OF ACCEPTANCE. Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

716-07.01 POT-DESIGN STRUCTURAL BRIDGE BEARINGS

SCOPE: This specification covers the material requirements for pot-design structural bridge bearings. Bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.

GENERAL: Pot-design structural bridge bearings shall be supplied as fixed bearings; guided expansion bearings; and non-guided expansion bearings as designated by the Contract Documents.

1. Fixed Bearings. Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot.

2. Guided Expansion Bearings. Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. Guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot. To allow longitudinal movement, the upper surface of the steel piston shall be faced with polytetrafluorethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel. To restrict transverse movement, either a guide bar or keyway system shall be used. If required, the guide bar or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.

3. Non-Guided Expansion Bearings. Non-guided expansion bearings shall allow rotation, longitudinal, and transverse movement in the bearing plane. Non-guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot. To allow longitudinal and transverse movement, the upper surface of the steel piston shall be faced with polytetrafluorethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel.

MATERIAL REQUIREMENTS: All materials shall be new and unused, with no reclaimed material incorporated in the finished bearing.

Elastomeric Rotational Element. The elastomeric rotational element used in the construction of pot-design bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The physical properties of neoprene and natural rubber used in these bearings shall conform to the following ASTM or AASHTO requirements, with modifications as noted.

Elastomeric Compound	ASTM Requirement	AASHTO Standard Specifications For Bridge
Neoprene	D2000, Line Call Out M2BC517A14B34	Section 2.25.2, Materials, 50 Durometer Hardness.
Natural Rubber	D2000, Line Call Out M4AA517A13B33	Section 2.25.2, Materials, 50 Durometer Hardness.

1. The Shore A Durometer hardness shall be 50±10 points.

2. Samples for compression set tests shall be prepared using a type 2 die. The compression set of the neoprene specimens shall not exceed 35%. The compression set of the natural rubber specimens shall not exceed 25%.

3. For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded off to the nearest 10 psi for tensile strength, to the nearest 10% for elongation, and to the nearest 1% for the change in aged tensile and aged elongation. Hardness and aged hardness shall be rounded off to the nearest point.

Sealant: If used, the type of sealant between the steel base pot and the top steel bearing plate shall be as recommended by the manufacturer.

Sealing Rings: The sealing rings between the steel piston and the elastomeric rotational element shall be brass formed to the size recommended by the manufacturer.

Steel: All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual.

Stainless Steel: Stainless steel shall conform to the requirements of ASTM A-167, or ASTM A-240, Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8, bright mirror finish (less than 10 micro-inches root mean square). The minimum thickness of the stainless steel shall be 0.050 inches.

Polytetrafluorethylene Sheet and Strip. Polytetrafluorethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not reprocessed) unfilled TFE resin; or from TFE resin uniformly blended with either 15% glass fiber or 25% carbon (maximum filler, percent by weight).

MATERIAL REQUIREMENTS: All materials shall be new and unused, with no reclaimed material incorporated in the finished bearing.

Elastomeric Rotational Element. The elastomeric rotational element used in the construction of pot-design bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The physical properties of neoprene and natural rubber used in these bearings shall conform to the following ASTM or AASHTO requirements, with modifications as noted.

Elastomeric Compound	ASTM Requirement	AASHTO Standard Specifications For Bridge
Neoprene	D2000, Line Call Out M2BC517A14B34	Section 2.25.2, Materials, 50 Durometer Hardness.
Natural Rubber	D2000, Line Call Out M4AA517A13B33	Section 2.25.2, Materials, 50 Durometer Hardness.

1. The Shore A Durometer hardness shall be 50±10 points.
2. Samples for compression set tests shall be prepared using a type 2 die. The compression set of the neoprene specimens shall not exceed 35%. The compression set of the natural rubber specimens shall not exceed 25%.
3. For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded off to the nearest 10 psi for tensile strength, to the nearest 10% for elongation, and to the nearest 1% for the change in aged tensile and aged elongation. Hardness and aged hardness shall be rounded off to the nearest point.

Sealant: If used, the type of sealant between the steel base pot and the top steel bearing plate shall be as recommended by the manufacturer.

Sealing Rings: The sealing rings between the steel piston and the elastomeric rotational element shall be brass formed to the size recommended by the manufacturer.

Steel: All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual.

Stainless Steel: Stainless steel shall conform to the requirements of ASTM A-167, or ASTM A-240, Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8, bright mirror finish (less than 10 micro-inches root mean square). The minimum thickness of the stainless steel shall be .050 inches.

Polytetrafluorethylene Sheet and Strip. Polytetrafluorethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not reprocessed) unfilled TFE resin; or from TFE resin uniformly blended with 25% carbon (maximum filler, percent

PTFE sheet shall be bonded to or recessed into its steel substrate. Bonded PTFE sheet shall be etched on its bonding side, and shall have a minimum thickness of 1/16 inch. Recessed PTFE sheet shall have a minimum thickness of 1/8 inch and be recessed for at least one-half its thickness into its steel substrate. The surface of filled PTFE sheet in contact with stainless steel shall be polished or burnished to insure smooth and low friction movement of the bearing.

Finished PTFE sheet and strip shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from -360°F to +500°F, non-flammable, non-absorbing of water, and shall conform to the following physical requirements:

		REQUIREMENTS		
Physical Property	ASTM Test Method	Unfilled	Filled 15% Glass	25% Carbon
Ultimate Tensile Strength, psi, min.	D638	2800	2000	1300
Ultimate Elongation, %, min.	D638	200	150	75
Specific Gravity, min.	D792	2.13	2.18	2.05

FABRICATION DETAILS: The finish of the mold used to produce the elastomeric rotational elements shall conform to good machine practice. Every bearing shall have the Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The PTFE sheet shall be bonded to its grit blasted steel substrate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its steel substrate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded shall be shop painted with one coat of coal-tar epoxy. Coal-tar epoxy paint shall meet the requirements of SSPC Paint Specification No. 16, and be applied at a minimum wet film thickness of 10 mils. Prior to painting, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.010". Out-of-flatness greater than 0.010" on any

plate shall be cause for rejection. The bottom surface of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 0.0625" (1/16"). Oxygen cut surfaces shall not exceed a surface roughness value of 1000 micro-inches, as defined by ANSI B46.1. Repair, when necessary, shall conform to the requirements of the New York State Steel Construction Manual.

The steel base pot of all bearings shall be either integrally machined or continuously welded to its bottom steel masonry plate. Unless otherwise approved by the D.C.E.S., all welding shall conform to, and all welders shall be qualified in accordance with the requirements of the New York State Steel Construction Manual.

Gross bearing dimensions shall have a tolerance of -0, +1/8".

PERFORMANCE CHARACTERISTICS:

Compression Strain: For all types of pot-design bearings, compression strains (deflections) shall be recorded for incremental compression stresses of 500 psi, until a stress corresponding to 150% of the bearing's design capacity has been attained. Compression stress shall be based on the internal diameter of the steel base pot.

A load equal to 150% of the bearing's design capacity shall first be applied to seat the bearing components. The 150% load shall then be gradually reduced over a time period of 30 to 90 seconds, to a pre-load equal to 5% of the bearing's design capacity. Each compression strain shall be recorded relative to the initial pre-load deflection, one minute after the desired stress level has been reached, by dial indicators, at four locations 90° apart on the perimeter of the bearing.

The test results will be evaluated as follows:

1. The bearing will be visually examined both during and after the test. Any resultant visual defects (such as extruded elastomer, damaged seals, or cracked steel) shall be cause for rejection.

2. Non-uniform compression deflections at a desired stress level shall be cause for rejection.

Sliding Coefficient of Friction: For all guided and non-guided expansion type pot-design bearings, the sliding coefficients of friction shall be measured at the bearing's design capacity, on the fifth and fiftieth cycles, at a sliding speed of 1 inch per minute.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

The test results will be evaluated as follows:

1. The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction.

2. The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged bearing components) shall be cause for rejection.

Rotation: For all pot-design bearings, the elastomeric rotational element shall be capable of maintaining its initial uniform contact with the steel piston and steel base pot throughout a rotation range of 0.02 radians (1.1456°), under a compressive load equal to 150% of the design capacity of the bearing.

The test results will be evaluated as follows:

1. The bearing will be visually examined both during and after the test. Any resultant visual defects shall be cause for rejection.

2. The sole plate, top bearing plate, and steel piston shall maintain continuous and uniform contact for the duration of the test. Any observed "lift-off" shall be cause for rejection.

DRAWINGS. The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the New York State Steel Construction Manual, for approval by the Deputy Chief Engineer (Structures) prior to the start of fabrication.

In addition to the above requirements, the Manufacturer shall note the following on the shop drawings.

1. The total quantity of each kind of pot-design bearing required, (i.e. fixed, guided expansion, or non-guided expansion), grouped first according to type (load range) and then by actual design capacity.

2. The thickness and plan area of the elastomeric rotational elements and the internal diameters of the steel base pots required.

3. The maximum design coefficient of friction as noted on the Contract Plans.

4. The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler.

5. The type(s) of steel(s) to be used.

6. If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of the New York State Steel Construction Manual shall be clearly described and detailed.

7. The location of the fabrication plant.

8. The Manufacturer's name and the name of his representative who will be responsible for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of bearing fabrication. This notification shall include all of the information required by numbers 1 through 8 above. A copy of this notification shall be sent to the Deputy Chief Engineer (Structures).

SAMPLING AND TESTING

Lot Size. Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as the smallest number of bearings as determined by the following criteria:

1. A lot shall not exceed a single contract or project quantity;

2. A lot shall not exceed 25 bearings.

3. A lot shall consist of those bearings of the same type, regardless of load capacity. Bearing types shall be fixed type bearings or expansion type bearings. Guided and Non-Guided expansion bearings will be considered a single type.

Sampling and Testing Requirements. The manufacturer shall furnish the required number of samples to perform testing in accordance with Table 1.

A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of production bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

Bearings with tapered sole plates which are selected for testing by the Materials Bureau, shall be delivered to the test site accompanied by a single unattached matching beveled plate. This plate shall be made of the same material and be the same size and thickness as the tapered sole plate. Additionally, the single beveled plate shall be so constructed that when placed in contact with the tapered sole plate the two shall form a single body, rectangular in shape and uniform in thickness.

The manufacturer shall select, at random, the required sample bearing(s) from completed lots of bearings for testing by the manufacturer. He shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling and acceptance consideration.

The Department's representative shall select, at random, the required sample bearing(s) from completed lots of bearings, and samples of the elastomeric and PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

The Contractor shall assume the cost of transporting all samples from the place of manufacture to the Materials Bureau and return, or, if applicable, to the project site.

TABLE 1 SAMPLING AND TESTING REQUIREMENTS

Test	Performed By	Samples Required
Rotation	Manufacturer	One production bearing per lot (Note 1)
Coefficient of Friction	Manufacturer	One production bearing per lot (Note 1)
Compression Strain	Materials Bureau	a) For bearings with load capacities less than 600,000 lbs.; three production bearings per lot. (Note 2) b) For bearings with load capacities greater than 600,000 lbs.; three production bearings per lot, tested by an outside laboratory approved by the Materials Bureau (Note 3).
Physical Properties of Elastomeric Rotational Element	Materials Bureau	One Elastomeric element per lot. (Note 4)
Physical properties of PTFE sheet	Materials Bureau	One 10"X15" sheet of PTFE material per project (Note 5).

NOTE 1: Sample production bearings of such size that cannot be tested by the manufacturer at 150% design capacity for rotation shall be tested at actual design capacity. Bearings which are tested at actual design capacity will be tested at that capacity because it is not possible, or not practical in the Department's opinion to test them at a higher capacity. Therefore, bearings tested at 150% design capacity which are rejected, will not be retested below 150% design capacity for the purpose of rendering such bearings acceptable.

Sample production bearings that cannot be tested by the Manufacturer at their actual design capacity for rotation and/or friction shall be tested by an outside laboratory selected by the Materials Bureau. The Manufacturer shall assume the cost of this testing and submit the certified test results to the Materials Bureau.

NOTE 2: Production bearings of such size that cannot be tested by the Materials Bureau at 150% design capacity for compression strain shall be tested at their actual design capacity.

NOTE 3: The Department shall assume the cost of this testing. The Contractor shall be responsible for transportation scheduling and costs. All bearings shall be made available for return to the Contractor.

NOTE 4: At the time of sampling the Department representative shall remove an elastomeric rotational element from a production bearing (not from a bearing that requires compressive strain testing) and forward it to the Materials Bureau for test. This testing will be destructive and the manufacturer shall, at his cost, replace the sample elastomeric element.

NOTE 5: The sample sheet of PTFE material shall be certified by the Manufacturer as having been taken from the same batch of material as was used in the actual production bearings.

BASIS OF ACCEPTANCE: Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

PAY ITEMS FOR SECTION 565

ITEM NO.	ITEM		PAY UNIT
565.1101	TYPE S.R. Expansion Bearing	(0 to 100 KIP)	Each
565.1102	TYPE S.R. Expansion Bearing	(101 to 150 KIP)	"
565.1103	TYPE S.R. Expansion Bearing	(151 to 200 KIP)	"
565.1104	TYPE S.R. Expansion Bearing	(201 to 250 KIP)	"
565.1105	TYPE S.R. Expansion Bearing	(251 to 300 KIP)	"
565.1106	TYPE S.R. Expansion Bearing	(301 to 350 KIP)	"
565.1107	TYPE S.R. Expansion Bearing	(351 to 400 KIP)	"
565.1108	TYPE S.R. Expansion Bearing	(401 to 450 KIP)	"
565.1109	TYPE S.R. Expansion Bearing	(451 to 500 KIP)	"
565.1110	TYPE S.R. Expansion Bearing	(501 to 550 KIP)	"
565.1111	TYPE S.R. Expansion Bearing	(551 to 600 KIP)	"
565.1112	TYPE S.R. Expansion Bearing	(601 to 700 KIP)	"
565.1113	TYPE S.R. Expansion Bearing	(701 to 800 KIP)	"
565.1114	TYPE S.R. Expansion Bearing	(801 to 900 KIP)	"
565.1115	TYPE S.R. Expansion Bearing	(901 to 1000 KIP)	"
565.1116	TYPE S.R. Expansion Bearing	(10001 to 1100 KIP)	"
565.1117	TYPE S.R. Expansion Bearing	(1101 to 1200 KIP)	"
565.1118	TYPE S.R. Expansion Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1201	TYPE S.R. Fixed Bearing	(0 to 100 KIP)	Each
565.1202	TYPE S.R. Fixed Bearing	(101 to 150 KIP)	"
565.1203	TYPE S.R. Fixed Bearing	(151 to 200 KIP)	"
565.1204	TYPE S.R. Fixed Bearing	(201 to 250 KIP)	"
565.1205	TYPE S.R. Fixed Bearing	(251 to 300 KIP)	"
565.1206	TYPE S.R. Fixed Bearing	(301 to 350 KIP)	"
565.1207	TYPE S.R. Fixed Bearing	(351 to 400 KIP)	"
565.1208	TYPE S.R. Fixed Bearing	(401 to 450 KIP)	"
565.1209	TYPE S.R. Fixed Bearing	(451 to 500 KIP)	"
565.1210	TYPE S.R. Fixed Bearing	(501 to 550 KIP)	"
565.1211	TYPE S.R. Fixed Bearing	(551 to 600 KIP)	"
565.1212	TYPE S.R. Fixed Bearing	(601 to 700 KIP)	"
565.1213	TYPE S.R. Fixed Bearing	(701 to 800 KIP)	"
565.1214	TYPE S.R. Fixed Bearing	(801 to 900 KIP)	"
565.1215	TYPE S.R. Fixed Bearing	(901 to 1000 KIP)	"
565.1216	TYPE S.R. Fixed Bearing	(1001 to 1100 KIP)	"
565.1217	TYPE S.R. Fixed Bearing	(1101 to 1200 KIP)	"
565.1218	TYPE S.R. Fixed Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1301	TYPE S.S. Expansion Bearing	(0 to 100 KIP)	Each
565.1302	TYPE S.S. Expansion Bearing	(101 to 150 KIP)	"
565.1303	TYPE S.S. Expansion Bearing	(151 to 200 KIP)	"
565.1304	TYPE S.S. Expansion Bearing	(201 to 250 KIP)	"
565.1305	TYPE S.S. Expansion Bearing	(251 to 300 KIP).	"
565.1306	TYPE S.S. Expansion Bearing	(301 to 350 KIP)	"
565.1307	TYPE S.S. Expansion Bearing	(351 to 400 KIP)	"
565.1308	TYPE S.S. Expansion Bearing	(401 to 450 KIP)	"
565.1309	TYPE S.S. Expansion Bearing	(451 to 500 KIP)	"
565.1310	TYPE S.S. Expansion Bearing	(501 to 550 KIP)	"
565.1311	TYPE S.S. Expansion Bearing	(551 to 600 KIP)	"
565.1312	TYPE S.S. Expansion Bearing	(601 to 700 KIP)	"
565.1313	TYPE S.S. Expansion Bearing	(701 to 800 KIP)	"
565.1314	TYPE S.S. Expansion Bearing	(801 to 900 KIP)	"
565.1315	TYPE S.S. Expansion Bearing	(901 to 1000 KIP)	"
565.1316	TYPE S.S. Expansion Bearing	(1001 to 1100 KIP)	"
565.1317	TYPE S.S. Expansion Bearing	(1101 to 1200 KIP)	"
565.1318	TYPE S.S. Expansion Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1401	TYPE S.S. Fixed Bearing	(0 to 100 KIP)	Each
565.1402	TYPE S.S. Fixed Bearing	(101 to 150 KIP)	"
565.1403	TYPE S.S. Fixed Bearing	(151 to 200 KIP)	"
565.1404	TYPE S.S. Fixed Bearing	(201 to 250 KIP)	"
565.1405	TYPE S.S. Fixed Bearing	(251 to 300 KIP)	"
565.1406	TYPE S.S. Fixed Bearing	(301 to 350 KIP)	"
565.1407	TYPE S.S. Fixed Bearing	(351 to 400 KIP)	"
565.1408	TYPE S.S. Fixed Bearing	(401 to 450 KIP)	"
565.1409	TYPE S.S. Fixed Bearing	(451 to 500 KIP)	"
565.1410	TYPE S.S. Fixed Bearing	(501 to 550 KIP)	"
565.1411	TYPE S.S. Fixed Bearing	(551 to 600 KIP)	"
565.1412	TYPE S.S. Fixed Bearing	(601 to 700 KIP)	"
565.1413	TYPE S.S. Fixed Bearing	(701 to 800 KIP)	"
565.1414	TYPE S.S. Fixed Bearing	(801 to 900 KIP)	"
565.1415	TYPE S.S. Fixed Bearing	(901 to 1000 KIP)	"
565.1416	TYPE S.S. Fixed Bearing	(1001 to 1100 KIP)	"
565.1417	TYPE S.S. Fixed Bearing	(1101 to 1200 KIP)	"
565.1418	TYPE S.S. Fixed Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1501	TYPE M.R. Guided Expansion Bearing	(0 to 100 KIP)	Each
565.1502	TYPE M.R. Guided Expansion Bearing	(100 to 150 KIP)	"
565.1503	TYPE M.R. Guided Expansion Bearing	(151 to 200 KIP)	"
565.1504	TYPE M.R. Guided Expansion Bearing	(201 to 250 KIP)	"
565.1505	TYPE M.R. Guided Expansion Bearing	(251 to 300 KIP)	"
565.1506	TYPE M.R. Guided Expansion Bearing	(301 to 351 KIP)	"
565.1507	TYPE M.R. Guided Expansion Bearing	(351 to 400 KIP)	"
565.1508	TYPE M.R. Guided Expansion Bearing	(401 to 450 KIP)	"
565.1509	TYPE M.R. Guided Expansion Bearing	(451 to 500 KIP)	"
565.1510	TYPE M.R. Guided Expansion Bearing	(501 to 550 KIP)	"
565.1511	TYPE M.R. Guided Expansion Bearing	(551 to 600 KIP)	"
565.1512	TYPE M.R. Guided Expansion Bearing	(601 to 700 KIP)	"
565.1513	TYPE M.R. Guided Expansion Bearing	(701 to 800 KIP)	"
565.1514	TYPE M.R. Guided Expansion Bearing	(801 to 900 KIP)	"
565.1515	TYPE M.R. Guided Expansion Bearing	(901 to 1000 KIP)	"
565.1516	TYPE M.R. Guided Expansion Bearing	(1001 to 1100 KIP)	"
565.1517	TYPE M.R. Guided Expansion Bearing	(1101 to 1200 KIP)	"
565.1518	TYPE M.R. Guided Expansion Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1601	TYPE M.R. Non-Guided Expansion Bearing	(0 to 100 KIP)	EACH
565.1602	TYPE M.R. Non-Guided Expansion Bearing	(101 to 150 KIP)	"
565.1603	TYPE M.R. Non-Guided Expansion Bearing	(151 to 200 KIP)	"
565.1604	TYPE M.R. Non-Guided Expansion Bearing	(201 to 250 KIP)	"
565.1605	TYPE M.R. Non-Guided Expansion Bearing	(251 to 300 KIP)	"
565.1606	TYPE M.R. Non-Guided Expansion Bearing	(301 to 350 KIP)	"
565.1607	TYPE M.R. Non-Guided Expansion Bearing	(351 to 400 KIP)	"
565.1608	TYPE M.R. Non-Guided Expansion Bearing	(401 to 450 KIP)	"
565.1609	TYPE M.R. Non-Guided Expansion Bearing	(451 to 500 KIP)	"
565.1610	TYPE M.R. Non-Guided Expansion Bearing	(501 to 550 KIP)	"
565.1611	TYPE M.R. Non-Guided Expansion Bearing	(551 to 600 KIP)	"
565.1612	TYPE M.R. Non-Guided Expansion Bearing	(601 to 700 KIP)	"
565.1613	TYPE M.R. Non-Guided Expansion Bearing	(701 to 800 KIP)	"
565.1614	TYPE M.R. Non-Guided Expansion Bearing	(800 to 900 KIP)	"
565.1615	TYPE M.R. Non-Guided Expansion Bearing	(901 to 1000 KIP)	"
565.1616	TYPE M.R. Non-Guided Expansion Bearing	(1001 to 1100 KIP)	"
565.1617	TYPE M.R. Non-Guided Expansion Bearing	(1101 to 1200 KIP)	"
565.1618	TYPE M.R. Non-Guided Expansion Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1701	TYPE M.R. Fixed Bearing	(0 to 100 KIP)	Each
565.1702	TYPE M.R. Fixed Bearing	(101 to 150 KIP)	"
565.1703	TYPE M.R. Fixed Bearing	(151 to 200 KIP)	"
565.1704	TYPE M.R. Fixed Bearing	(201 to 250 KIP)	"
565.1705	TYPE M.R. Fixed Bearing	(251 to 300 KIP)	"
565.1706	TYPE M.R. Fixed Bearing	(301 to 350 KIP)	"
565.1707	TYPE M.R. Fixed Bearing	(351 to 400 KIP)	"
565.1708	TYPE M.R. Fixed Bearing	(401 to 450 KIP)	"
565.1709	TYPE M.R. Fixed Bearing	(451 to 500 KIP)	"
565.1710	TYPE M.R. Fixed Bearing	(501 to 550 KIP)	"
565.1711	TYPE M.R. Fixed Bearing	(551 to 600 KIP)	"
565.1712	TYPE M.R. Fixed Bearing	(601 to 700 KIP)	"
565.1713	TYPE M.R. Fixed Bearing	(701 to 800 KIP)	"
565.1714	TYPE M.R. Fixed Bearing	(801 to 900 KIP)	"
565.1715	TYPE M.R. Fixed Bearing	(901 to 1000 KIP)	"
565.1716	TYPE M.R. Fixed Bearing	(1001 to 1100 KIP)	"
565.1717	TYPE M.R. Fixed Bearing	(1101 to 1200 KIP)	"
565.1718	TYPE M.R. Fixed Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1801	TYPE E.P. Bearing	(0 to 100 KIP)	Each
565.1802	TYPE E.P. Bearing	(101 to 150 KIP)	"
565.1803	TYPE E.P. Bearing	(151 to 200 KIP)	"
565.1804	TYPE E.P. Bearing	(201 to 250 KIP)	"
565.1805	TYPE E.P. Bearing	(251 to 300 KIP)	"
565.1806	TYPE E.P. Bearing	(301 to 350 KIP)	"
565.1807	TYPE E.P. Bearing	(351 to 400 KIP)	"
565.1808	TYPE E.P. Bearing	(401 to 450 KIP)	"
565.1809	TYPE E.P. Bearing	(451 to 500 KIP)	"
565.1810	TYPE E.P. Bearing	(501 to 550 KIP)	"
565.1811	TYPE E.P. Bearing	(551 to 600 KIP)	"
565.1812	TYPE E.P. Bearing	(601 to 700 KIP)	"
565.1813	TYPE E.P. Bearing	(701 to 800 KIP)	"
565.1814	TYPE E.P. Bearing	(801 to 900 KIP)	"
565.1815	TYPE E.P. Bearing	(901 to 1000 KIP)	"
565.1816	TYPE E.P. Bearing	(1001 to 1100 KIP)	"
565.1817	TYPE E.P. Bearing	(1101 to 1200 KIP)	"
565.1818	TYPE E.P. Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.1901	TYPE E.L. Bearing	(0 to 100 KIP)	Each
565.1902	TYPE E.L. Bearing	(101 to 150 KIP)	"
565.1903	TYPE E.L. Bearing	(151 to 200 KIP)	"
565.1904	TYPE E.L. Bearing	(201 to 250 KIP)	"
565.1905	TYPE E.L. Bearing	(251 to 300 KIP)	"
565.1906	TYPE E.L. Bearing	(301 to 350 KIP)	"
565.1907	TYPE E.L. Bearing	(351 to 400 KIP)	"
565.1908	TYPE E.L. Bearing	(401 to 450 KIP)	"
565.1909	TYPE E.L. Bearing	(451 to 500 KIP)	"
565.1910	TYPE E.L. Bearing	(501 to 550 KIP)	"
565.1911	TYPE E.L. Bearing	(551 to 600 KIP)	"
565.1912	TYPE E.L. Bearing	(601 to 700 KIP)	"
565.1913	TYPE E.L. Bearing	(701 to 800 KIP)	"
565.1914	TYPE E.L. Bearing	(801 to 900 KIP)	"
565.1915	TYPE E.L. Bearing	(901 to 1000 KIP)	"
565.1916	TYPE E.L. Bearing	(1001 to 1100 KIP)	"
565.1917	TYPE E.L. Bearing	(1101 to 1200 KIP)	"
565.1918	TYPE E.L. Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY ITEM
565.2001	TYPE E.B. Bearing	(0 to 100 KIP)	Each
565.2002	TYPE E.B. Bearing	(101 to 150 KIP)	"
565.2003	TYPE E.B. Bearing	(151 to 200 KIP)	"
565.2004	TYPE E.B. Bearing	(201 to 250 KIP)	"
565.2005	TYPE E.B. Bearing	(251 to 300 KIP)	"
565.2006	TYPE E.B. Bearing	(301 to 350 KIP)	"
565.2007	TYPE E.B. Bearing	(351 to 400 KIP)	"
565.2008	TYPE E.B. Bearing	(401 to 450 KIP)	"
565.2009	TYPE E.B. Bearing	(451 to 500 KIP)	"
565.2010	TYPE E.B. Bearing	(501 to 550 KIP)	"
565.2011	TYPE E.B. Bearing	(551 to 600 KIP)	"
565.2012	TYPE E.B. Bearing	(601 to 700 KIP)	"
565.2013	TYPE E.B. Bearing	(701 to 800 KIP)	"
565.2014	TYPE E.B. Bearing	(801 to 900 KIP)	"
565.2015	TYPE E.B. Bearing	(901 to 1000 KIP)	"
565.2016	TYPE E.B. Bearing	(1001 to 1100 KIP)	"
565.2017	TYPE E.B. Bearing	(1101 to 1200 KIP)	"
565.2018	TYPE E.B. Bearing	(1201 KIP and over)	"

ITEM NO.	ITEM		PAY UNIT
565.2101	TYPE E.S. Guided Bearing	(0 to 100 KIP)	Each
565.2102	TYPE E.S. Guided Bearing	(101 to 150 KIP)	"
565.2103	TYPE E.S. Guided Bearing	(151 to 200 KIP)	"
565.2104	TYPE E.S. Guided Bearing	(201 to 250 KIP)	"
565.2105	TYPE E.S. Guided Bearing	(251 to 300 KIP)	"
565.2106	TYPE E.S. Guided Bearing	(301 to 350 KIP)	"
565.2107	TYPE E.S. Guided Bearing	(351 to 400 KIP)	"
565.2108	TYPE E.S. Guided Bearing	(401 to 450 KIP)	"
565.2109	TYPE E.S. Guided Bearing	(451 to 500 KIP)	"
565.2110	TYPE E.S. Guided Bearing	(501 to 550 KIP)	"
565.2111	TYPE E.S. Guided Bearing	(551 to 600 KIP)	"
565.2112	TYPE E.S. Guided Bearing	(601 to 700 KIP)	"
565.2113	TYPE E.S. Guided Bearing	(701 to 800 KIP)	"
565.2114	TYPE E.S. Guided Bearing	(801 to 900 KIP)	"
565.2115	TYPE E.S. Guided Bearing	(901 to 1000 KIP)	"
565.2116	TYPE E.S. Guided Bearing	(1001 to 1100 KIP)	"
565.2117	TYPE E.S. Guided Bearing	(1101 to 1200 KIP)	"
565.2118	TYPE E.S. Guided Bearing	(1201 KIP and over)	"
565.2201	TYPE E.S. Non-Guided Bearing	(0 to 100 KIP)	"
565.2202	TYPE E.S. Non-Guided Bearing	(101 to 150 KIP)	"
565.2203	TYPE E.S. Non-Guided Bearing	(151 to 200 KIP)	"
565.2204	TYPE E.S. Non-Guided Bearing	(201 to 250 KIP)	"
565.2205	TYPE E.S. Non-Guided Bearing	(251 to 300 KIP)	"
565.2206	TYPE E.S. Non-Guided Bearing	(301 to 350 KIP)	"
565.2207	TYPE E.S. Non-Guided Bearing	(351 to 400 KIP)	"
565.2208	TYPE E.S. Non-Guided Bearing	(401 to 450 KIP)	"
565.2209	TYPE E.S. Non-Guided Bearing	(451 to 500 KIP)	"
565.2210	TYPE E.S. Non-Guided Bearing	(501 to 550 KIP)	"
565.2211	TYPE E.S. Non-Guided Bearing	(551 to 600 KIP)	"
565.2212	TYPE E.S. Non-Guided Bearing	(601 to 700 KIP)	"
565.2213	TYPE E.S. Non-Guided Bearing	(701 to 800 KIP)	"
565.2214	TYPE E.S. Non-Guided Bearing	(801 to 900 KIP)	"
565.2215	TYPE E.S. Non-Guided Bearing	(901 to 1000 KIP)	"
565.2216	TYPE E.S. Non-Guided Bearing	(1001 to 1100 KIP)	"
565.2217	TYPE E.S. Non-Guided Bearing	(1101 to 1200 KIP)	"
565.2218	TYPE E.S. Non-Guided Bearing	(1201 KIP and over)	"