



**Series 1500**  
**Laminated Bellows Expansion Joints**

Catalog 1103

## Series 1500 Laminated Bellows Expansion Joints

- Sizes 2" through 14" IPS.
- Design conditions of full vacuum to 150 and 300 PSIG at 500°F.
- Axial travel up to 3.0 inches
- Maximum flexibility and extended life
- Low spring rates and pressure thrust

Pipe expansion or contraction resulting from temperature changes is independent of line size; however, the bellows elements of small diameter expansion joints have less ability to absorb motion than larger sizes because of restrictions on the corrugation size. Recognizing these shortcomings, Hyspan® developed Series 1500 Laminated Bellows Expansion Joints for applications that involve axial motion. The bellows elements are designed with up to four individual thicknesses or laminations of precision stainless steel foil. This design procedure combines the high flexibility of thin material while providing the pressure resistance of

multiple laminations. As a comparison, a bellows made from four plies of 0.008" thick material has the same pressure rating as a single thickness of 0.016" thick, but the laminated construction will deflect twice as much and requires only one-half the force to compress.

The laminated bellows is integrated into the design by installing it on the inside diameter of the pipe. This method has the advantage of providing reinforcement of the bellows neck and attachment weld, and reducing the effective area of the bellows and the corresponding pressure thrust. The pressure thrust force of Series 1500 Laminated Bellows Expansion Joints ranges from 40–70% of comparable products.

All Series 1500 Laminated Bellows Expansion Joints include a stainless steel flow liner. The flow liner

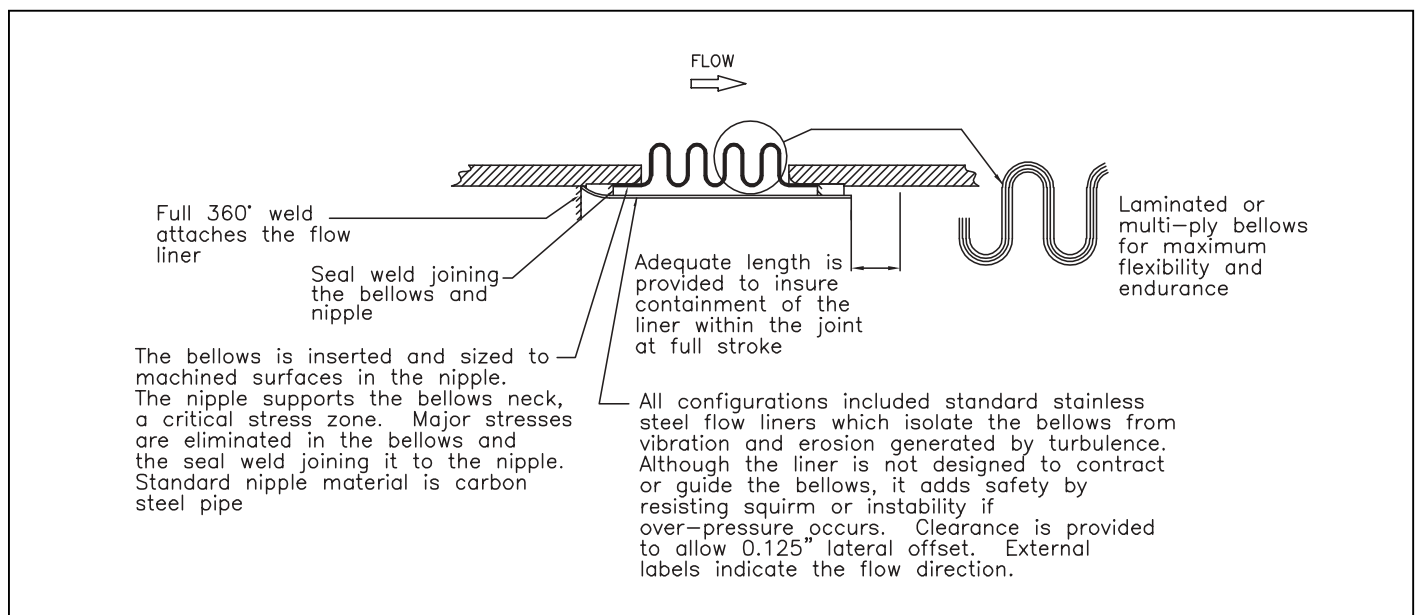
eliminates added pressure drop resulting from the bellows, protects the bellows from the flow, and as a precaution provides a stop to resist squirm or bellows instability in the event of over-pressurization.

Correctly applied and properly installed, Series 1500 Laminated Bellows Expansion Joints offer the most reliable, yet economical, pipe expansion compensation available. The all-metal welded construction permits service to 500°F for standard models. The laminated design and low effective area assure that minimum loads are transferred to adjacent piping, and provide extended life at full stroke.

### Warranty

Full five year replacement warranty  
— see page 7 for details.

## Design Features



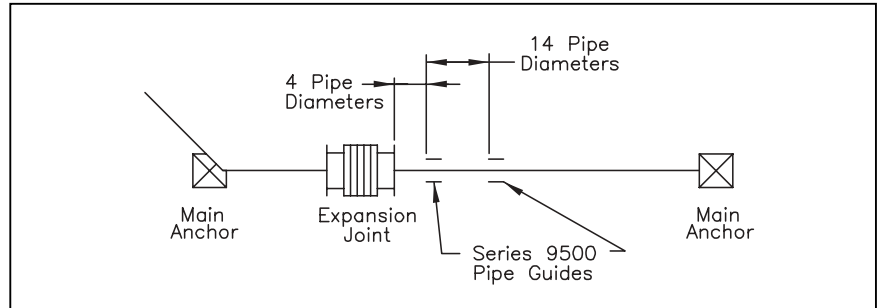


## Applications

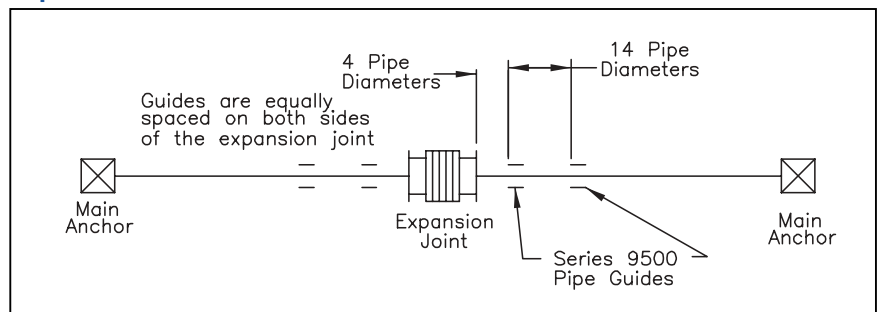
Series 1500 Laminated Bellows Expansion Joints are designed for installations where the principal movement is axial. Standard joints are designed for 2" or 3" axial compression (pipe expansion) and 0.5" and 0.75" extension respectively. If the primary movement is extension (pipe contraction) the joint can be preset at the factory. The piping system must include anchors to react the force produced by pressure thrust and the bellows spring constant, supports to react the weight of the pipe and media, and guides to ensure that the pipe alignment is maintained.

See Hyspan Series 9500 Catalog 1004 for guide spacing in the center of pipe runs.

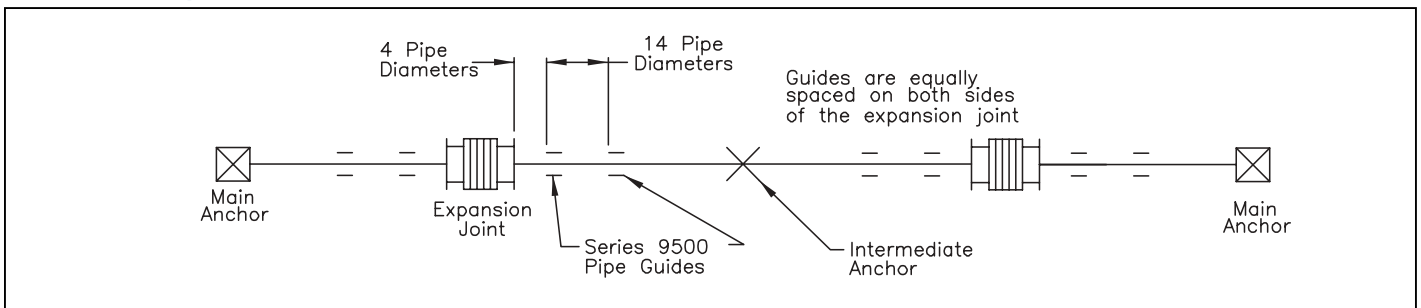
### Expansion Joint Adjacent to Main Anchor



### Expansion Joint Located in the Middle of a Run



### Two or More Expansion Joints with Intermediate Anchors



## Anchor Forces

In order to ensure that the pipe movement is absorbed by the expansion joint, the end of the runs must have a rigid structural reaction or main anchor. Main anchors must

react the pressure thrust and bellows spring force. Ideally intermediate anchors have balanced forces on each side of the anchor (if the pipe size is unchanged), however, it is

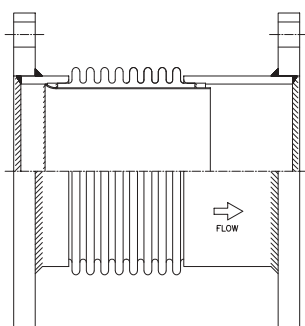
recommended that the minimum design force should be equal to the bellows spring force at full travel.

$$\text{Main Anchor Force (lbs)} = \left\{ \begin{array}{l} \text{Pressure Thrust*} \\ \text{Force (lbs.) Table 1} \end{array} \right\} + \left\{ \begin{array}{l} \text{Spring Rate (lbs./in.)} \\ \text{Column 3 Table 2 or 3} \end{array} \right\} \times \left\{ \begin{array}{l} \text{Axial Travel (inches)} \\ \text{Column 2 Table 2 or 3} \end{array} \right\}$$

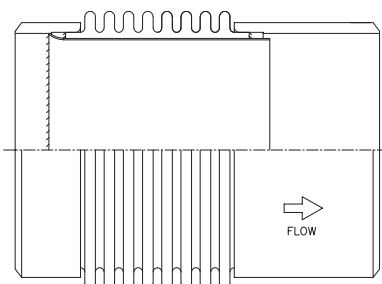
$$\text{Intermediate Anchor Force (lbs.)} = \left\{ \begin{array}{l} \text{Spring Rate (lbs./in.)} \\ \text{Column 3 Table 2 or 3} \end{array} \right\} \times \left\{ \begin{array}{l} \text{Axial Travel (inches)} \\ \text{Column 2 Tables 2 or 3} \end{array} \right\}$$

\*Use maximum pressure – including test pressure

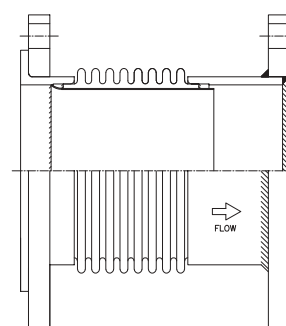
**1501 Fixed Flange**



**1502 Weld End**



**1504 Fixed/Floating Flange**



Flanges: Flat face carbon steel made from ASME A-36 plate. Outside diameter and drilling per ASME/ANSI B16.5. Table 2 designs—150 lb. drilling, Table 3 designs—300 lb. drilling.

Pipe: Schedule 40 ASME A53 Grade B. Model 1502 weld preparation per ASME/ANSI B16.9

Lap Joint Stub Ends: Schedule 40 ASME/ANSI B16.9 carbon steel. Back-up flange construction same as flanges above.

Bellows: Laminated (multiply) ASTM A240 type 321 stainless steel 3" diameter and under, type 304 over 3" diameter.

Flow Liner: ASTM A240 type 304 stainless steel.

**Table 1**  
**Pressure and Force Data/Laminated Expansion Joints—Types 1501, 1502 & 1504**

Nominal Size NPS	Effective Area (square inches)	Tabulated Force (pounds) for Individual Pressures													
		50 PSI	75 PSI	100 PSI	125 PSI	150 PSI	175 PSI	200 PSI	225 PSI	250 PSI	300 PSI	350 PSI	400 PSI	450 PSI	
2	4.1	208	312	415	519	623	727	831	935	1039	1246	1454	1662	1870	
2-1/2	5.8	290	436	581	726	872	1017	1162	1307	1453	1743	2034	2324	2615	
3	8.8	445	667	889	1112	1334	1556	1779	2001	2223	2668	3113	3557	4002	
4	15.4	774	1161	1548	1935	2322	2709	3097	3484	3871	4645	5419	6193	6967	
5	23.5	1179	1769	2358	2948	3538	4127	4717	5307	5896	7076	8255	9434	10614	
6	33.3	1669	2504	3339	4173	5008	5843	6677	7512	8347	10016	11686	13355	15024	
8	56.8	2840	4261	5681	7101	8522	9942	11362	12783	14203	17043	19884	22725	25565	
10	87.2	4362	6544	8725	10906	13088	15269	17450	19631	21813	26175	30538	34900	39263	
12	122	6146	9219	12291	15364	18437	21510	24583	27656	30729	36874	43020	49166	55312	
14	152	7600	11400	15200	19000	22800	26600	30400	34200	38000	45600	53200	60800	68400	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

**Note:** Tabulated data is force produced by pressure only. Refer to Column 3 of Tables 2 & 3 for force resulting from bellows stiffness.



**Table 2 Design Pressure: 150 psig Test Pressure: 225 psig Design Temperature: 500°F**

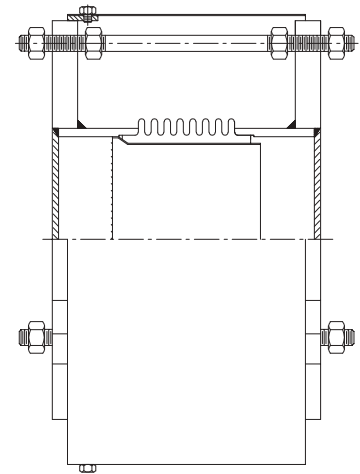
Nominal Size NPS	Axial Deflection (inches)	Axial Spring Rate (lb/in)	Part Number 1501 1502 1504	1501 & 1504		1502	
				Overall Length (inches)	Weight (lbs)	Overall Length (inches)	Weight (lbs)
2	2	58	-131-2.0	11	13	10.5	3
	3	43	-131-3.0	14	15	13.5	4
2 1/2	2	72	-135-2.0	11	19	10.5	5
	3	54	-135-3.0	14	21	13.5	7
3	2	93	-140-2.0	11	23	10.5	6
	3	70	-140-3.0	14	25	13.5	9
4	2	207	-148-2.0	11	30	10.5	9
	3	155	-148-3.0	14	35	13.5	13
5	2	253	-155-2.0	11	37	10.5	12
	3	190	-155-3.0	14	42	13.5	17
6	2	464	-160-2.0	11	44	10.5	16
	3	348	-160-3.0	14	51	13.5	23
8	2	434	-167-2.0	11	63	10.5	24
	3	325	-167-3.0	14	74	13.5	35
10	2	548	-174-2.0	11.5	102	11	34
	3	411	-174-3.0	14.5	117	14	49
12	2	818	-180-2.0	11.5	136	11	40
	3	614	-180-3.0	14.5	154	14	58
14	2	809	-181-2.0	11.5	147	11	43
	3	607	-181-3.0	14.5	166	14	63
1	2	3	4	5	6	7	8

**Table 3 Design Pressure: 300 psig Test Pressure: 450 psig Design Temperature: 500°F**

Nominal Size NPS	Axial Deflection (inches)	Axial Spring Rate (lb/in)	Part Number 1501 1502 1504	1501 & 1504		1502	
				Overall Length (inches)	Weight (lbs)	Overall Length (inches)	Weight (lbs)
2	2	125	-331-2.0	12	17	11.5	3
	2.5	109	-331-2.5	13.5	18	13.0	4
2 1/2	2	153	-335-2.0	12	23	11.5	6
	2.5	134	-335-2.5	13.5	24	13.0	7
3	2	197	-340-2.0	12	28	11.5	7
	2.5	172	-340-2.5	13.5	29	13.0	9
4	2	519	-348-2.0	12	39	11.5	10
	2.5	454	-348-2.5	13.5	42	13.0	13
5	2	634	-355-2.0	12	46	11.5	14
	2.5	555	-355-2.5	13.5	50	13.0	17
6	2	652	-360-2.0	12	71	11.5	18
	2.5	570	-360-2.5	13.5	76	13.0	23
8	2	934	-367-2.0	12	99	11.5	28
	2.5	817	-367-2.5	13.5	106	13.0	35
10	2	1174	-374-2.0	12.5	141	11.5	39
	2.5	1027	-374-2.5	14.0	151	13.5	49
12	2	1980	-380-2.0	12.5	184	11.5	46
	2.5	1733	-380-2.5	14.0	196	13.5	58
14	2	2119	-381-2.0	12.5	199	11.5	50
	2.5	1854	-381-2.5	14.0	212	13.5	63
1	2	3	4	5	6	7	8

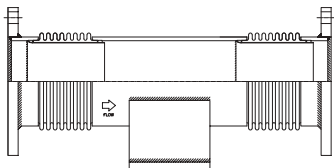
## Optional Features

Series 1500 Laminated Bellows Expansion Joints are available with optional features such as limit rods and removable covers. The function of limit rods is to restrict the movement of the bellows in the event of over-travel. In the event of an anchor failure the rods are designed to react the full pressure thrust force. Covers are available to protect the bellows from damage resulting from falling objects, welding slag etc., or to allow for the installation of external insulation that does not contact the bellows.

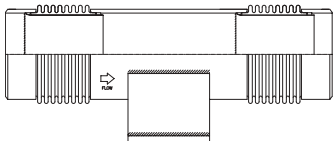


## Dual Center Anchor Base Configurations

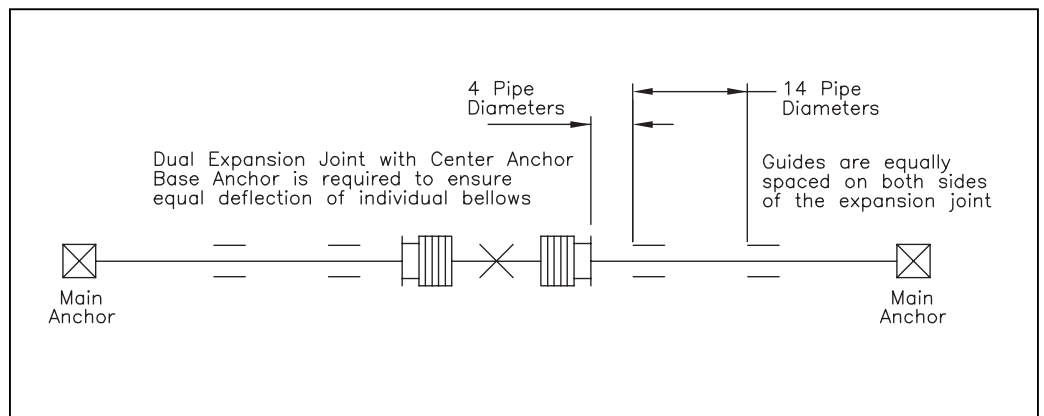
If the expansion or contraction of a straight run exceeds the motion capability of a single joint, two or more single joints can be installed separated by an intermediate anchor as illustrated on Page 3. As an alternative, a Dual Center Anchor Base Expansion Joint can be installed which incorporates two joints and an intermediate anchor.



**1505 Flanged Dual Center Anchor Base**

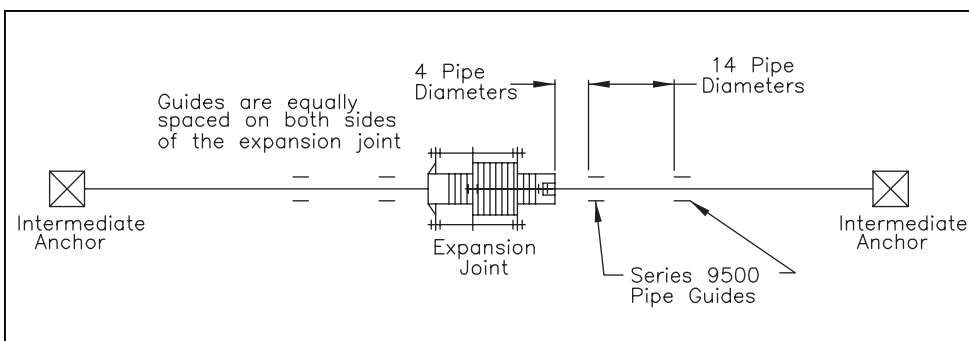


**1506 Weld End Dual Center Anchor Base**



## In-Line Pressure Balanced Expansion Joint

Since the pressure thrust force can be significant, there are applications where it is not possible to provide main anchors that are adequate to react the total force. Series 1500 Laminated Bellows Expansion Joints are available as in-line pressure balanced configurations. This configuration incorporates two bellows that are same diameter as the nominal line size, and a third bellows that has an effective area that is twice the line size bellows. They are linked together by internal linkage to react the pressure thrust. There is still a bellows spring force that requires an intermediate anchor—refer to Anchor Forces on page 3.



## Installation Procedure

**Operating Conditions:** Series 1500 Laminated Bellows Expansion Joints are supplied with a tag attached stating the Design Pressure. The maximum test pressure is 1.5 times the design pressure. The design temperature for all standard joints is 500°F. Consult the purchase specification for the allowable travel. Be certain that the system conditions and test conditions do not exceed these values.

**Guides, Supports, Anchors:** Series 1500 Laminated Bellows Expansion Joints are designed for applications where the principal movement is axial to the centerline of the expansion joint, and the system includes guides, supports and anchors. Refer to Page 3 for system requirements.

**Flow Direction:** Series 1500 Laminated Bellows Expansion Joints include a flow liner. The direction of flow is indicated on the exterior of the expansion joint. Confirm that the joint is orientated correctly.

**Shipping Restraints:** External restraints are installed at the factory to insure installation at the correct length and alignment. They are painted yellow and labeled – Shipping Bars, Remove after Installation. Leave these restraints installed until after the installation of the expansion joint is complete – but they must be removed prior to pressure testing. *CAUTION: they are not designed to react the pressure thrust of the expansion joint – they must be removed prior to testing. Normally the shipping restraints are installed by welding – provide protection for the bellows element from cutting or grinding during removal.*

**Limit Rods:** Standard Series 1500 Laminated Bellows Expansion Joints do not include tie rods or control rods that limit travel, but they are available as an option. If rods are included, be certain that they are adjusted to allow the design movement of the expansion joint.

### Post Installation Inspection

1. Inspect the expansion joint for damage with close attention to the bellows element.
2. Is the expansion joint installed at the correct location; and are the anchors, guides and supports installed in accordance with the system design?
3. Are the guides and support free to allow the movement of the expansion joint.
4. Is the flow direction correct?
5. Are the Shipping Restraints removed?

### FIVE YEAR LIMITED WARRANTY

This warranty is given by HYSpan PRECISION PRODUCTS, INC. (HYSpan) for the benefit of the first purchasers for use of its Series 1500 Laminated Bellows Expansion Joints manufactured by HYSpan to standard catalog construction or standard construction with laminated Alloy 625 bellows. The product is warranted to be free from defects in material and workmanship for a period of five (5) years from the date of shipment by HYSpan in accordance with the following conditions:

1. The design pressure and temperature are not exceeded – including surge and upset conditions.
2. The installation conforms to HYSpan installation instructions and approved practice for anchoring, supporting and guiding, and generally accepted good piping practice.
3. Substances in contact with all internal and external surfaces must be compatible with the materials of construction, including all contaminants. Steam, condensate, and water containing more than 100 parts per million chlorides are specifically excluded when stainless bellows are used, Inconel bellows construction qualifies.
4. The warranty shall be limited to the replacement by HYSpan of the same model Series 1500 expansion joint, and payment for transportation by the least expensive method. Labor, material and other costs related to the failure or replacement of the expansion joint are not included. HYSpan shall not be liable for damage or delay suffered by the purchaser, regardless of whether such damages are general, special or consequential in nature, whether caused by defective material or workmanship, or whether caused by HYSpan's negligence regardless of the degree.
5. The warranty is limited to installations in the United States, Puerto Rico and Canada.

The purchaser shall advise the HYSpan factory of any warranty claim, including the nature of the failure. HYSpan shall provide return goods authorization and shipping directions to return the failed joint to the factory. A mutually agreeable delivery schedule and method of shipping the replacement shall be established. The purchaser shall furnish a confirming purchase order and is obligated to the current replacement cost of the joint and shipping expense. Upon receipt of the failed product, the cause of failure shall be determined by the factory at no expense to the purchaser. A credit shall be issued by the factory for the replacement cost and least expensive shipping for valid warranty claims. In the event of a dispute, HYSpan shall furnish the failed product to the purchaser or their representative for failure analysis.



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