

Quality Control Procedure



Inryco

an Inland Steel company

Procedure Number

QC 1021

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Subject

ANCHORAGE MEASUREMENT CONTROL

Section

QUALITY CONTROL

Effective Date

1-19-83

1. SCOPE

The procedure shall establish the means of verifying the acceptability of various thread mating dimensions for the Inryco 170 wire post-tensioning anchorage system, by measurement of the critical thread dimensions.

2. PURPOSE

This procedure shall be used to acquire the necessary data for determining the acceptability of various thread dimension combinations of 170W1B Field Anchorhead or 170W15 Bushing to stressing ram Adaptor.

3. RESPONSIBILITY

It shall be the responsibility of the Owner or his agent to provide the necessary actions stated within this procedure, to assure that damage to the tendons or equipment or injuries to personnel shall not occur during stressing or detensioning of tendon anchorages. It is suggested that this information be provided to those vendors that are being submitted Request To Bid specification for In-Service-Inspection (Tendon Surveillance).

4. MEASURING EQUIPMENT

The following devices are recommended for the measurements to be performed and shall be controlled for calibration to the required accuracy and frequency.

1. Standard outside measuring micrometer, readable to 0.001" or finer (0.0001").
2. Inside measuring micrometer readable to 0.001" or finer (0.0001"), with changable anvils, small contact area or point style anvils as well as standard inside measuring anvils. For convenience, more than one micrometer may be used.
3. Go and No-Go thread plug gauges.
4. Standard stub ACME, 3 wire sets of thread measuring wires.
5. Shim stock (about 0.020" thickness to prevent flexing).

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5. MEASURING THREADS

A combination square with a centering head should be used to assure that the measurements are diametrically opposite each other and that the second reading is nearly perpendicular to the first reading. Crayon or soapstone can be used to mark the measuring locations, but care should be taken so as not to permit those marks to interfere with the accuracy of the measurements.

1. USE OF MICROMETER

Proper use of the micrometer is essential when measuring large diameters. The fixed anvil must be held at one point of the measurement and the spindle is rocked back and forth at the opposite point of measurements, while the thimble is rotated to acquire the greatest, true diametric reading. The thimble should be locked after each reading, before being removed from the measurement. This will assure reading accuracy and permit rechecks with consistent repeatability.

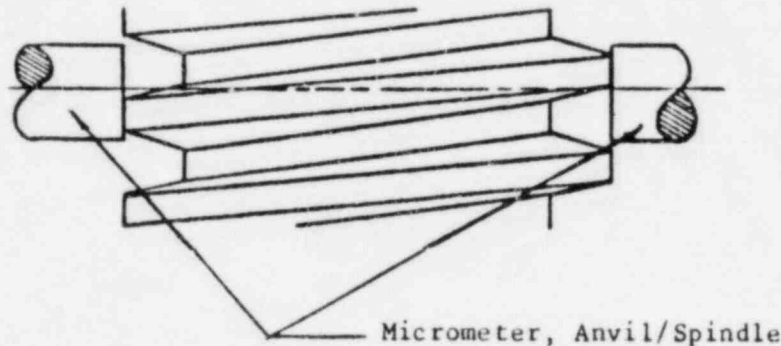
6. EXTERNAL THREADS - ANCHORAGES

All external thread measurements shall be taken at the 3rd, 6th and 9th threads. Two readings shall be taken for each thread and each reading shall be taken at right angles to the other. This measurement shall only apply to 170W1B Field Anchorheads and 170W15 Bushings.

1. MAJOR DIAMETER

This measurement shall be taken with a standard outside measuring micrometer and performed as shown in Sketch 1 below. The micrometer measurement will directly provide the major diameter dimension.

SKETCH 1 - External Major Diameter



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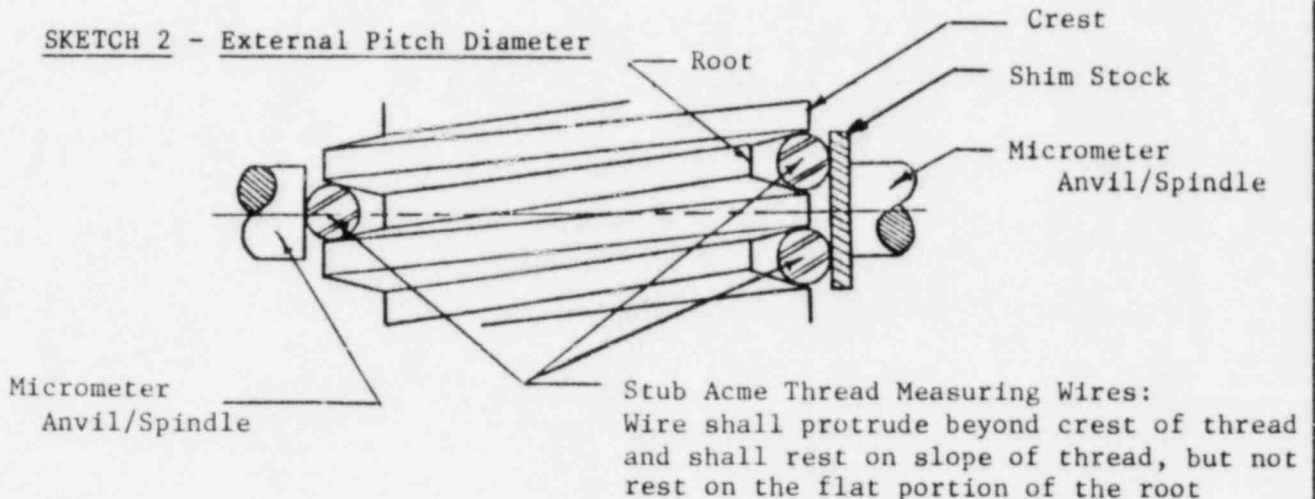
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6. 2. PITCH DIAMETER

This measurement shall be taken with a standard outside measuring micrometer, shim stock and 3 thread measuring wires for standard stub ACME threads. The 3 wires shall be of the same diameter, within the specified accuracy tolerances. The diameter may range from 0.129" to 0.162" but shall be selected so that the measuring wire rests on the tapered sides of the thread, protruding beyond the crest of the thread, but not resting on the flat portion of the root of the thread. The shim is used to retain the wires and permit the anvil to rest on the shim bridge across the wires and can be seen in Sketch 2 below.

NOTE: Some equipment manufacturers provide special thread wire holding attachments for certain micrometers, which facilitate the measuring process.

SKETCH 2 - External Pitch Diameter



- The pitch diameter constant shall be provided by Table A in Attachment 2 for the diameter of wire being used. The shim thickness shall be added to the constant and this total subtracted from the micrometer reading, thus providing the pitch diameter. It should be noted that the constant already considers all the wire diameters.

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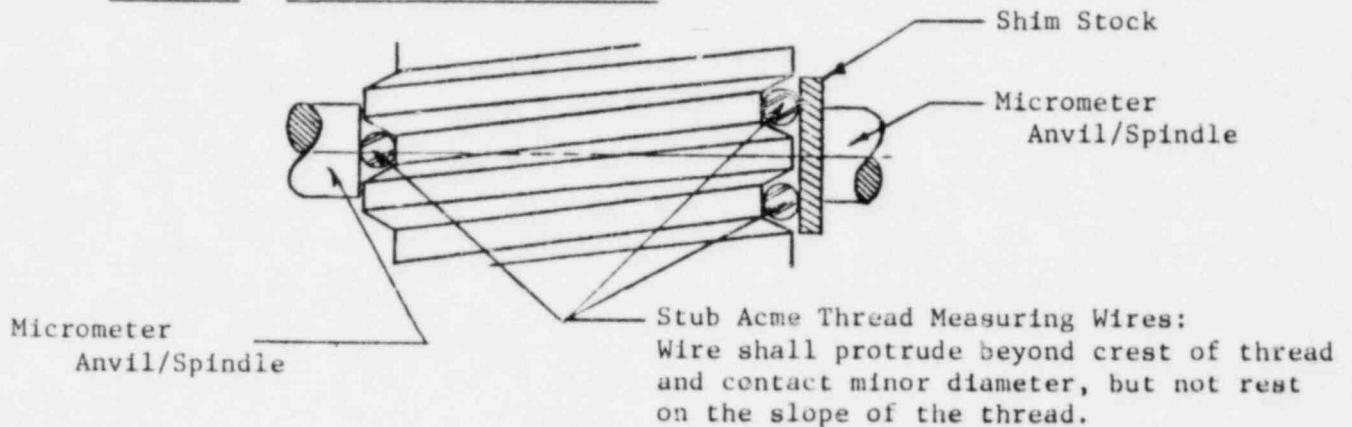
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6. 3. MINOR DIAMETER

This measurement shall be taken with a standard outside measuring micrometer, shim stock and 3 thread measuring wires of the same diameter. The diameter of the wire shall be selected so that it rests on the root flat of the thread, protruding beyond the crest of the thread, but not resting on the tapered sides of the thread. As noted in Section 6.2 above, the shim shall again be used to contact the 2 wires to bridge the thread permitting measurement, as seen in Sketch 3 below.

SKETCH 3 - External Minor Diameter



1. The sum of twice the selected wire diameter shall be added to the shim thickness, then this total dimension shall be subtracted from the micrometer reading to provide the minor diameter dimension.

7. INTERNAL THREADS - STRESSING RAM ADAPTOR

The locations for the measurement of major and minor diameters shall be specified in each section below. Two readings shall be taken for each thread and each reading shall be taken at right angles to the other. Pitch diameter shall be checked with thread plug gauges. This measurement shall only apply to stressing ram Adaptors.

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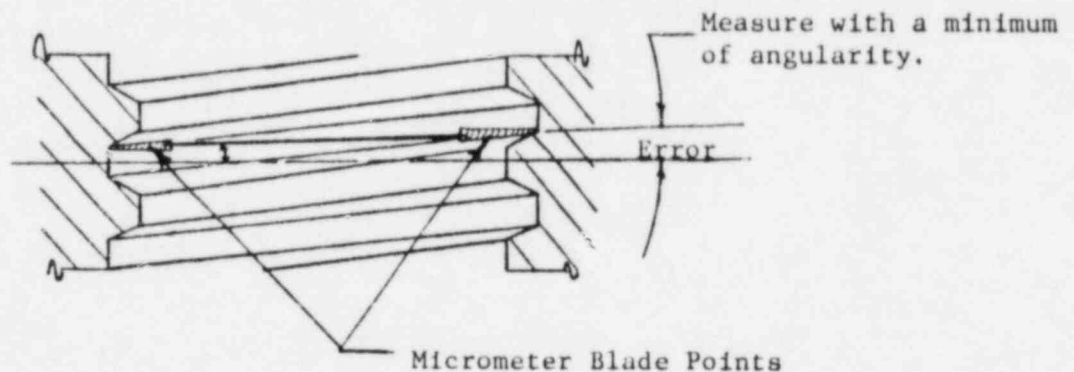
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7. 1. MAJOR DIAMETER

This measurement shall be taken at the 3rd and 9th threads of the stressing Adaptor, avoiding incomplete threads, with an inside measuring micrometer utilizing small contact area or point style anvils, in the manner shown in Sketch 4 below. Care shall be exercised to keep the angular error to a minimum as shown in Figure 4. The angular alignment introduces an error of 0.00013" or less and therefore shall be disregarded. The micrometer measurement will directly provide the inside major diameter dimension.

SKETCH 4 - Internal Major Diameter



2. PITCH DIAMETERS

Thread curvature does not readily permit measurement. Instead, Go and No-Go thread plug gauges shall be used to verify the acceptability of pitch diameter.

1. The Go gauge should enter the thread full length. The satisfactory entry or non-entry shall be documented. The Go gauge check is relatively unimportant as it only checks the maximum metal limit and therefore may be waived by the authorized quality authority.
2. The No-Go gauge should not actually enter the thread, except for about a one-quarter to one-half turn of the gauge. If this gauge completely enters the thread, then that stressing ram Adaptor, shall be rejected. It would be advantageous to perform this check first, to validate the acceptability of the pitch diameter before performing actual measurements.

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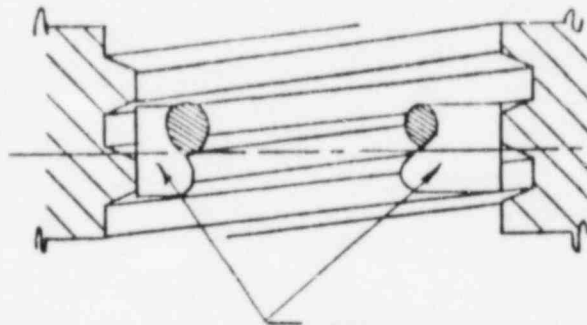
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7. 3. MINOR DIAMETER

This measurement shall be taken at the 3rd, 6th and 9th threads of the Adaptor, avoiding incomplete threads, with an inside measuring micrometer, preferably with a blade type anvil or other small contact area anvil, and performed as shown in Sketch 5 below. The micrometer reading will directly provide the inside minor diameter measurement.

SKETCH 5 - Internal Minor Diameter



Micrometer Blade Points



8. DOCUMENTATION

All measurements and required data shall be documented on a form identical or similar to the Typical Documentation Form shown in this procedure, Attachment 3.

1. With the measurement data posted to the documentation form, it shall become necessary to determine the average dimension for that measured characteristic.
 1. Add the readings together. Do this for each characteristic.
 2. Divide the total of each characteristic by the amount of readings. This shall provide the Average Dimension.
 3. Enter all calculations on to the documentation form.

9. REJECTION - STRESSING RAM ADAPTOR

If the stressing ram Adaptor fails the No-Go gauge check, that Adaptor shall not be used for any stressing or detensioning operations, as it may not have sufficient thread strength to withstand lift off or overstress loads.

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10. ACCEPTANCE - 9-3/8" - 4 STUB ACME THREAD

The recommended thread dimension stated by FED. STD. H28 APP.13 dated 8-31-78 for 9-3/8" threads are as follows:

EXTERNAL - ANCHORAGE			INTERNAL - ADAPTOR	
Maximum	Minimum		Maximum	Minimum
9.375	9.363	MAJOR	9.428	9.395
9.276	9.242	PITCH	9.333	9.300
9.205	9.172	MINOR	9.238	9.225

- As shown above, the minimum external to maximum internal dimensions will provide a strength equivalent to 138% of the tendon Guaranteed Ultimate Tensile Strength (GUTS). This strength equivalent has nothing to do with the forces applied to the tendon or anchorages. It only means that there is sufficient strength between the threads of an anchorage and the stressing adaptor to impart the required forces into the tendon during stressing or detensioning, without failing the threads of the stressing adaptor and/or the anchorage.
- If the measured thread dimensions meet those dimensions of Section 10 above, no nonconformance exists and the threads are acceptable.
- As the maximum stressing force applied to a tendon during stressing or detensioning is only 80% of tendon GUTS, (in certain cases 82%), it shall be acceptable to utilize a dimensional matchup between the 9-3/8" diameter anchorages and stressing adaptor which provides no less than 100% of tendon GUTS. While the anchorage threads are nonconforming, they have satisfactorily carried the previous stressing forces and can be expected to continue to do so, provided the actual thread sizes are not less than shown below.

EXTERNAL - ANCHORAGE			INTERNAL - ADAPTOR	
Minimum			Maximum	
9.290		MAJOR	9.428	
9.197		PITCH	9.333	
9.129		MINOR	9.238	

- As seen in the above chart, External Maximum and Internal Minimum threads are disregarded, as well as those combinations that exceed the stated control dimensions. Oversize external and less than minimum internal thread sizes would tend to produce tighter fits which would increase the strength equivalent. While this is a nonconforming condition, it does not affect the strength, as long as the anchorage can be threaded fully into the adaptor.

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10. 3. 2. All above strength equivalents are based on maintaining no less than 3 inches of thread engagement. Less than this engagement will reduce the strength equivalents.
3. The average Internal Maximum thread dimensions greater than those shown in the charts of Section 10 or 10.3 will also reduce the thread strength equivalents. It should be noted here, that the stressing adaptor has never been considered a safety-related component, even though it plays a very important part in maintaining thread strength equivalents.
1. As the stressing adaptor will wear more than anchorages due to frequency of use, extra care should be taken to assure that the threads do not exceed the control ranges.
 2. It is possible to utilize a stressing adaptor that exceeds the Internal Maximum dimensions providing the average External Minimum threads of the anchorage are proportionately larger. If it is decided that it is necessary to use an oversized stressing adaptor, then Inryco, Inc. should be consulted to verify the smallest dimensions that would be acceptable for matchup to that adaptor.

11. ACCEPTANCE - 6" - 4 STUB ACME THREAD

It shall not be necessary to perform any measurements of the 170W1A anchorhead or the 170W15 bushing interior threads. The current matchups shall be acceptable provided the bushing is returned to the same anchorhead from which it was removed and the threads fully engaged.

12. DOCUMENTATION

1. It is recommended that each stressing adaptor be permanently marked with a unique identification code, so that stressing performed with that device may be appropriately identified.
2. It is recommended that the identification code of a stressing adaptor be noted on the tendon stressing or detensioning quality control record.
3. The measurements of each anchorage and stressing adaptor shall be documented.
4. All documents shall be signed and dated and shall be maintained in accordance with the established requirements for that jobsite or power plant.

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13. ATTACHMENTS

Accompanying this procedure are the following documents.

1. Procedure QC 1021 - SAFETY COMMENTS 2 pages
2. Procedure QC 1021 - Table A - Constants
3. Procedure QC 1021 - Sample Documentation Form
4. Drawing 170W1A - For Information Only
5. Drawing 170W1B - For Information Only
6. Drawing 170W15 - For Information Only

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SAFETY COMMENTS

CAUTION

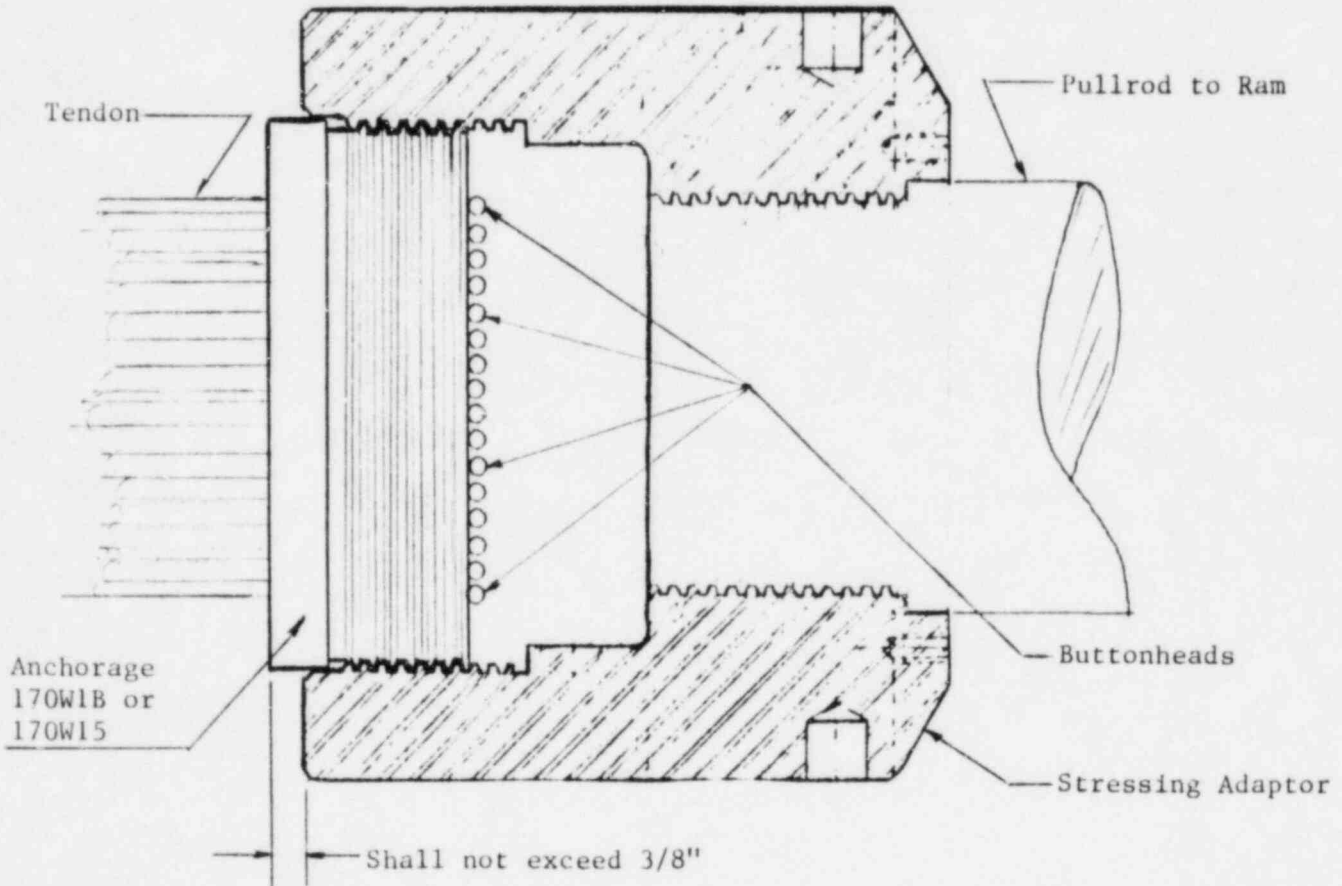
1. WORN THREADS OR POOR THREAD MATCH

VERIFY that an acceptable dimensional thread match exists between the stressing ram adaptor and the anchorage to be coupled. Before performing any coupling operations, the thread dimensions of the stressing ram adaptor and the thread dimensions of the anchorage to be coupled, shall be measured and compared for an acceptable match-up.

1. Refer to Inryco Procedure QC 1021 for controls.

2. STRESSING RAM ADAPTOR TO ANCHORAGE

VERIFY that the stressing ram adaptor (coupler) is fully engaged with the threads of the 17CW15 Bushing or the threads of the 170W1B Field Anchorhead, of that end of the tendon that shall have the jacking force applied. The anchorage shall not protrude more than 3/8 of an inch beyond the bottom outside face of the stressing ram adaptor, before starting any stressing or detensioning operations.



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3. SHOP ANCHORHEAD TO BUSHING

VERIFY that the 170W1A Shop Anchorhead does not protrude beyond the bottom face of the 170W15 Bushing. During coupling and uncoupling of the stressing ram adaptor with the Bushing, there is a possibility that the 170W1A Shop Anchorhead may become partially or completely unthreaded from the Bushing. This unthreading could occur as a result of tight, sticking or slightly damaged threads of either the stressing ram adaptor and the Bushing or both. Therefore, where a difficulty has been encountered in coupling the adaptor to the Bushing, especially where repeated threadon and unthreading has occurred, the proper engagement of the Shop Anchorhead with the Bushing shall be checked, prior to applying any jacking force to the tendon.

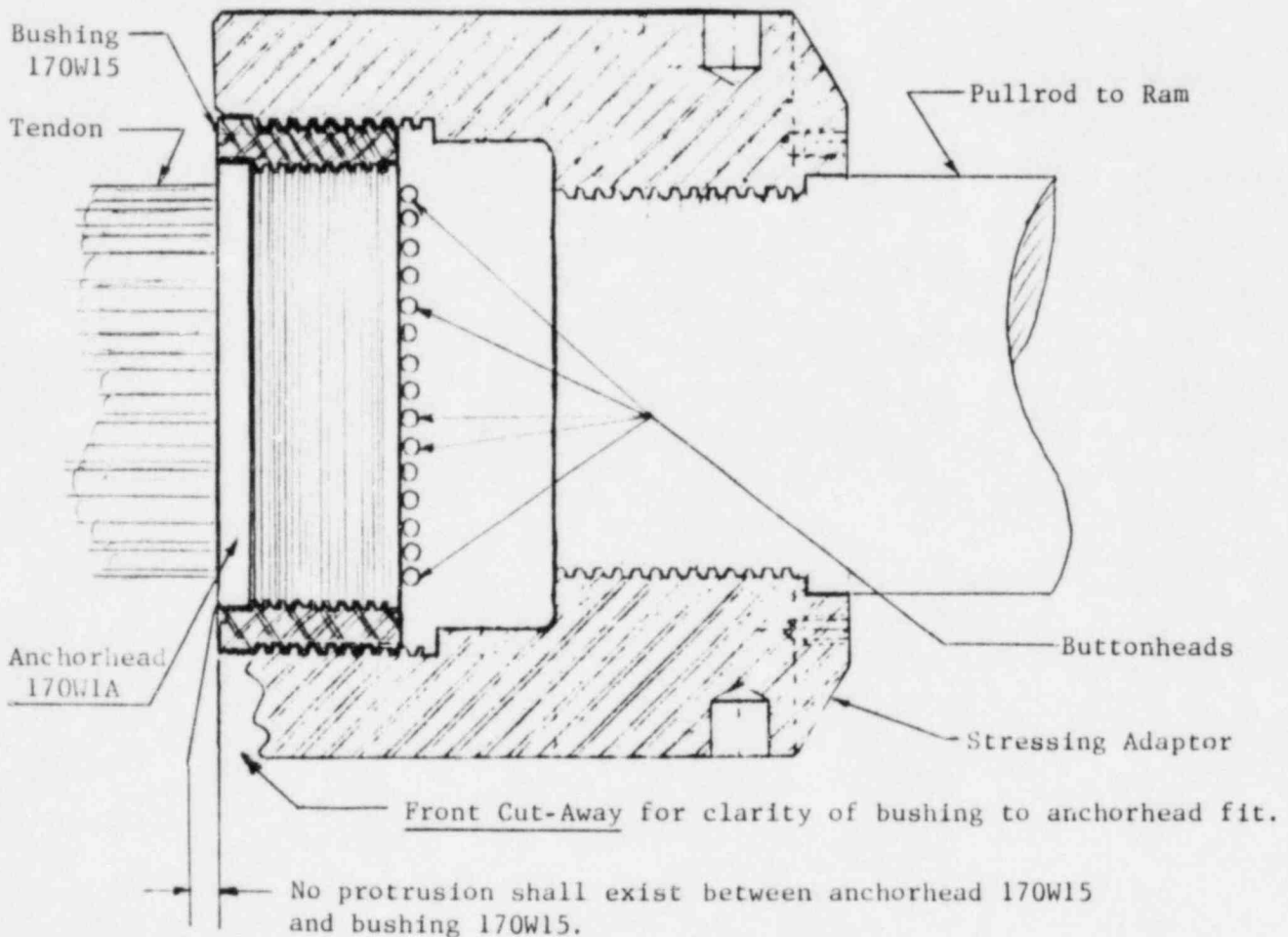




TABLE A

PITCH DIAM CONST FOR 3 WIRE METHOD

WIRE SIZE	CON.	WIRE SIZE	CON.	WIRE SIZE	CON.	WIRE SIZE	CON.	WIRE SIZE	CON.	WIRE SIZE	CON.	WIRE SIZE	CON.
.1290	.161	.1340	.186	.1390	.211	.1440	.236	.1490	.261	.1540	.286	.1590	.311
.1291	.161	.1341	.186	.1391	.211	.1441	.236	.1491	.261	.1541	.286	.1591	.311
.1292	.162	.1342	.187	.1392	.212	.1442	.237	.1492	.262	.1542	.287	.1592	.312
.1293	.162	.1343	.187	.1393	.212	.1443	.237	.1493	.262	.1543	.287	.1593	.312
.1294	.163	.1344	.188	.1394	.213	.1444	.238	.1494	.263	.1544	.288	.1594	.313
.1295	.163	.1345	.188	.1395	.213	.1445	.238	.1495	.263	.1545	.288	.1595	.313
.1296	.164	.1346	.189	.1396	.214	.1446	.239	.1496	.264	.1546	.289	.1596	.314
.1297	.164	.1347	.189	.1397	.214	.1447	.239	.1497	.264	.1547	.289	.1597	.314
.1298	.165	.1348	.190	.1398	.215	.1448	.240	.1498	.265	.1548	.290	.1598	.315
.1299	.165	.1349	.190	.1399	.215	.1449	.240	.1499	.265	.1549	.290	.1599	.315
.1300	.166	.1350	.191	.1400	.216	.1450	.241	.1500	.266	.1550	.291	.1600	.316
.1301	.166	.1351	.191	.1401	.216	.1451	.241	.1501	.266	.1551	.291	.1601	.316
.1302	.167	.1352	.192	.1402	.217	.1452	.242	.1502	.267	.1552	.292	.1602	.317
.1303	.167	.1353	.192	.1403	.217	.1453	.242	.1503	.267	.1553	.292	.1603	.317
.1304	.168	.1354	.193	.1404	.218	.1454	.243	.1504	.268	.1554	.293	.1604	.318
.1305	.168	.1355	.193	.1405	.218	.1455	.243	.1505	.268	.1555	.293	.1605	.318
.1306	.169	.1356	.194	.1406	.219	.1456	.244	.1506	.269	.1556	.294	.1606	.319
.1307	.169	.1357	.194	.1407	.219	.1457	.244	.1507	.269	.1557	.294	.1607	.319
.1308	.170	.1358	.195	.1408	.220	.1458	.245	.1508	.270	.1558	.295	.1608	.320
.1309	.170	.1359	.195	.1409	.220	.1459	.245	.1509	.270	.1559	.295	.1609	.320
.1310	.171	.1360	.196	.1410	.221	.1460	.246	.1510	.271	.1560	.296	.1610	.321
.1311	.171	.1361	.196	.1411	.221	.1461	.246	.1511	.271	.1561	.296	.1611	.321
.1312	.172	.1362	.197	.1412	.222	.1462	.247	.1512	.272	.1562	.297	.1612	.322
.1313	.172	.1363	.197	.1413	.222	.1463	.247	.1513	.272	.1563	.297	.1613	.322
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.1315	.173	.1365	.198	.1415	.223	.1465	.248	.1515	.273	.1565	.298	.1615	.323
.1316	.174	.1366	.199	.1416	.224	.1466	.249	.1516	.274	.1566	.299	.1616	.324
.1317	.174	.1367	.199	.1417	.224	.1467	.249	.1517	.274	.1567	.299	.1617	.324
.1318	.175	.1368	.200	.1418	.225	.1468	.250	.1518	.275	.1568	.300	.1618	.325
.1319	.175	.1369	.200	.1419	.225	.1469	.250	.1519	.275	.1569	.300	.1619	.325
.1320	.176	.1370	.201	.1420	.226	.1470	.251	.1520	.276	.1570	.301	.1620	.326
.1321	.176	.1371	.201	.1421	.226	.1471	.251	.1521	.276	.1571	.301	.1621	.326
.1322	.177	.1372	.202	.1422	.227	.1472	.252	.1522	.277	.1572	.302	.1622	.327
.1323	.177	.1373	.202	.1423	.227	.1473	.252	.1523	.277	.1573	.302	.1623	.327
.1324	.178	.1374	.203	.1424	.228	.1474	.253	.1524	.278	.1574	.303	.1624	.328
.1325	.178	.1375	.203	.1425	.228	.1475	.253	.1525	.278	.1575	.303	.1625	.328
.1326	.179	.1376	.204	.1426	.229	.1476	.254	.1526	.279	.1576	.304	.1626	.329
.1327	.179	.1377	.204	.1427	.229	.1477	.254	.1527	.279	.1577	.304	.1627	.329
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.1329	.180	.1379	.205	.1429	.230	.1479	.255	.1529	.280	.1579	.305	.1629	.330
.1330	.181	.1380	.206	.1430	.231	.1480	.256	.1530	.281	.1580	.306	.1630	.331
.1331	.181	.1381	.206	.1431	.231	.1481	.256	.1531	.281	.1581	.306	.1631	.331
.1332	.182	.1382	.207	.1432	.232	.1482	.257	.1532	.282	.1582	.307	.1632	.332
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.1334	.183	.1384	.208	.1434	.233	.1484	.258	.1534	.283	.1584	.308	.1634	.333
.1335	.183	.1385	.208	.1435	.233	.1485	.258	.1535	.283	.1585	.308	.1635	.333
.1336	.184	.1386	.209	.1436	.234	.1486	.259	.1536	.284	.1586	.309	.1636	.334
.1337	.184	.1387	.209	.1437	.234	.1487	.259	.1537	.284	.1587	.309	.1637	.334
.1338	.185	.1388	.210	.1438	.235	.1488	.260	.1538	.285	.1588	.310	.1638	.335
.1339	.185	.1389	.210	.1439	.235	.1489	.260	.1539	.285	.1589	.310	.1639	.335

SAMPLE DOCUMENTATION FORM

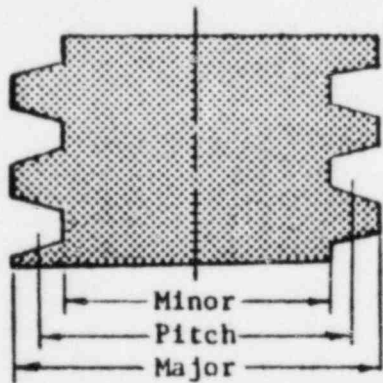
MINOR & MAJOR DIAMETER CHECKS - 1 TON W/B AMERICAN, 1 TON W/B BUSHING, STAMMING & KEAM ADAPTER

IDENTITY OF BALANCE GA ADAPTER	DIAMETER	MAJOR O.D. & MINOR I.D. DIAMETER CHECK				MINOR O.D. & MAJOR I.D. DIAMETER CHECK			MAJOR DIA. PITCH DIAMETER	REMARKS INSPECTED BY
		3RD THREAD	6TH THREAD	9TH THREAD	AVERAGE DIAMETER	3RD THREAD	9TH THREAD	AVERAGE DIAMETER		
	O.D.									
	I.D.									
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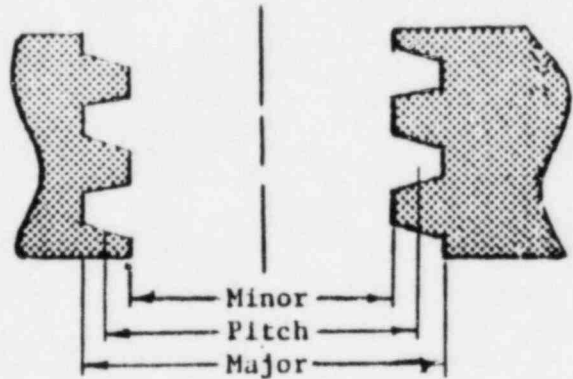
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 ID MICROMETER No. _____ Cal. Date _____
 MICROMETER No. _____ Cal. Date _____
 SAM SIZE _____ No. _____ Cal. Date _____
 WIRE SIZE _____ No. _____ Cal. Date _____
 GO-GAUGE No. _____ Cal. Date _____
 NO-GO-GAUGE No. _____ Cal. Date _____

THREAD NOMENCLATURE

The essential points of thread dimensional references are shown below to illustrate points of comparison for internal and external threads.

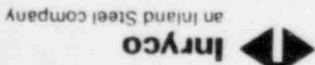


EXTERNAL THREAD



INTERNAL THREAD

FOR INFORMATION ONLY



PROCEDURE QC 1021

ATTACHMENT 4

DRAWING 170W1A

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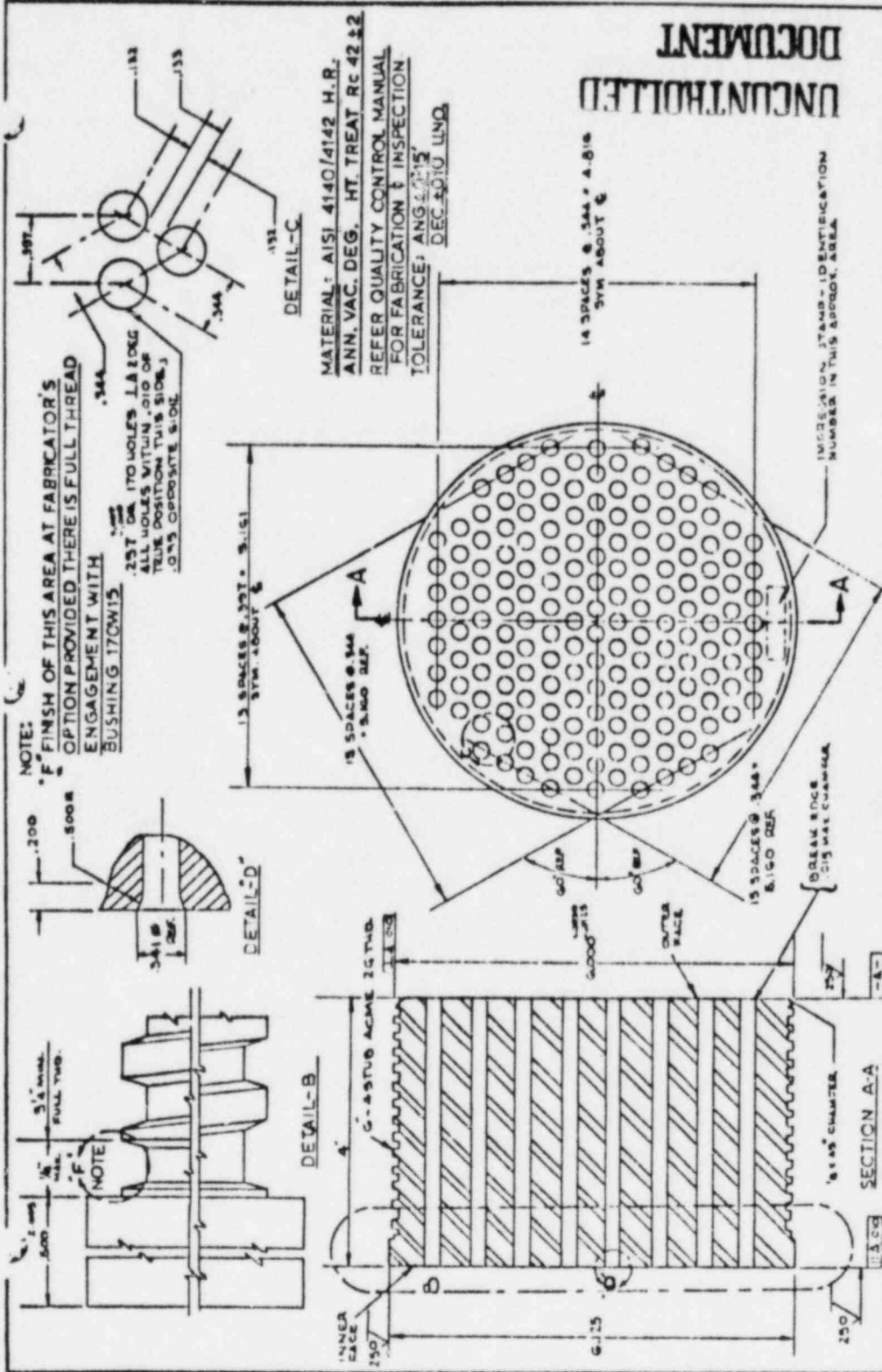
170 WIRE NUCLEAR SHOP ANCHOR HEAD

INLAND STEEL
CONSTRUCTION PRODUCTS COMPANY

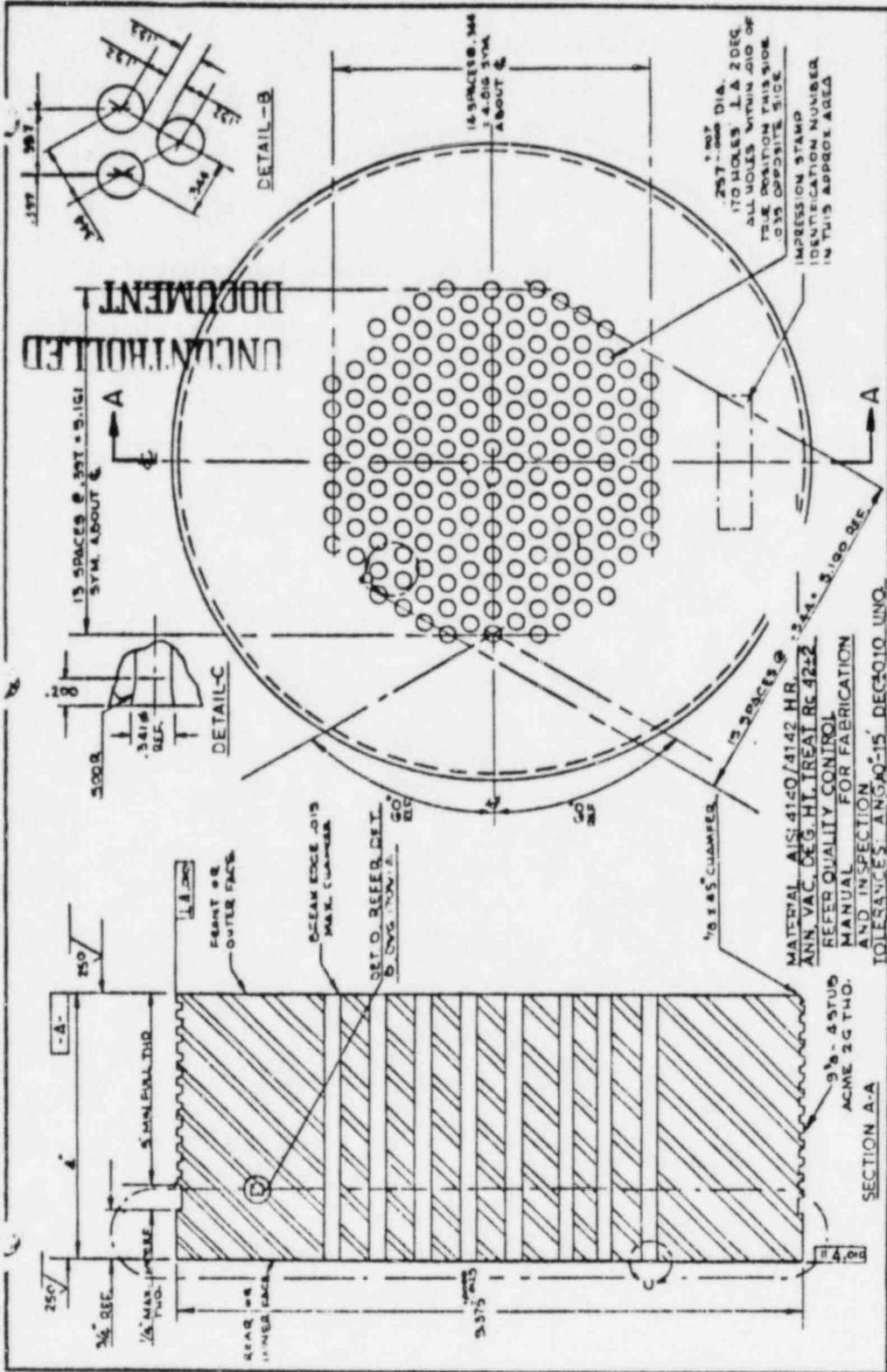
F 25T-TENSIONING DIVISION

170W1A

DATE: 2-26-71
DRAWN BY: RSD
APPROVED: [Signature]
CHECKED BY: [Signature]
DATE: 4-27-71
DRAWN BY: [Signature]
DATE: 5-4-81



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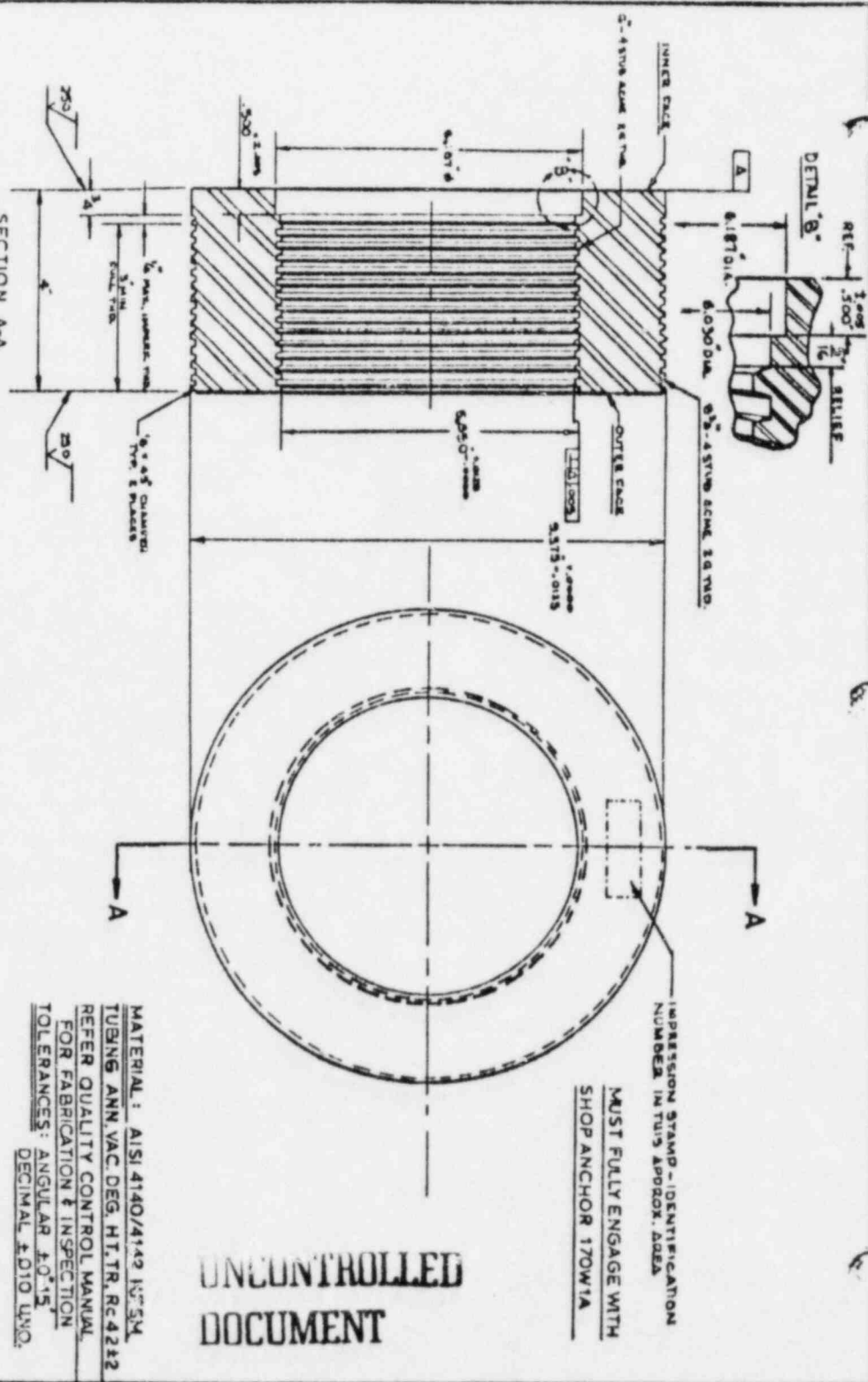


DATE 2-26-71
 DRAWN BY RSD
 APPROVED BY [Signature]
 170 W/B

INLAND-PIPERSON
 CONSTRUCTION PRODUCTS COMPANY
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UNCONTROLLED DOCUMENT

MATERIAL: AISI 4140/4142 W5M
TUBING ANN VAC DEG. HT. TR. RC4222
REFER QUALITY CONTROL MANUAL
FOR FABRICATION & INSPECTION
TOLERANCES: ANGULAR 40°-15'
DECIMAL ±.010 UMG.

170 WIRE NUCLEAR FIELD APPLIED BUSHING

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INLAND APPLIED CONSTRUCTION PRODUCTS COMPANY

POST-TENSIONING DIVISION

DRAWN BY RSD APPROVED BY DATE 2-26-71
