THE STATE OF SOUTH CAROLINA
In The Court of Appeals

RECEIVED
SEP 07 2018
SC Court of Appeals

APPEAL FROM SPARTANBURG COUNTY
Court of Common Pleas

Jean H. Toal, Circuit Court Judge

Appellate Case No. 2017-002611
Case No. 2016-CP-42-1592

Beverly Dale Jolly and Brenda Rice Jolly,..... Respondents,

v.

General Electric Company, et al., ... Defendants,

Of whom Fisher Controls International LLC and Crosby Valve, LLC are the ..... Appellants.

RECORD ON APPEAL
VOLUME IX

C. Mitchell Brown A. Mattison Bogan James B. Glenn Nicholas A. Charles NELSON MULLINS RILEY & SCARBOROUGH LLP 1320 Main Street / 17th Floor Post Office Box 11070 (29211-1070) Columbia, SC 29201 (803) 799-2000 Attorneys for Appellants Fisher Controls International LLC and Crosby Valve LLC	Theile B. McVey, Esq. John D. Kassel, Esq. KASSEL McVEY ATTORNEYS AT LAW Post Office Box 1476 1330 Laurel Street (29201) Columbia, SC 29201 Jonathan M. Holder, Esq. Lisa White Shirley, Esq. (*Pro Hac Vice)* DEAN OMAR BRANHAM, LLP 302 North Market Street, Suite 300 Dallas, TX 75202 jholder@dobllp.com Attorneys for Respondents

RECORD ON APPEAL
INDEX

VOLUME I

ORDERS and JUDGMENTS

Judge Toal's Order denying Fisher and Crosby's motion to quash Plaintiffs' trial subpoenas filed September 25, 2017; 1

Judge Toal's Order Denying Defendants' Post-Trial Motions and Granting Plaintiffs' Motion for New Trial Nisi Additur filed December 15, 2017 9

Judge Toal's Form 4 Order denying Fisher and Crosby's Joint Motion to Reconsider filed December 21, 2017; 48

VERDICT FORM

Verdict Form dated August 3, 2017 52

PLEADINGS

Plaintiffs' Complaint filed April 25, 2016; 55

Fisher's Answer filed June 6, 2016; 93

Crosby's Answer filed June 16, 2016; 111

TRANSCRIPTS

Transcript of July 18, 2017 motions hearing before Judge Toal 128

Transcript of July 21, 2017 telephonic hearing before Judge Toal 330

Transcript of Trial dated July 24, 2017, through August 3, 2017 336

July 24, 2017, Vol 1 336

July 25, 2017, Vol 2 405

VOLUME II

July 25, 2017, Vol 2 continued beginning page 500

July 26, 2017, Vol 3 655

VOLUME III

July 27, 2017, Vol 4 926

July 28, 2017, Vol 5 1173

July 31, 2017, Vol 6 1358

VOLUME IV

July 31, 2017, Vol 6 continued beginning page 1426

August 1, 2017, Vol 7 1586

August 2, 2017, Vol 8 1877

VOLUME V

August 2, 2017, Vol 8 continued beginning page.....1926
August 3, 2017, Vol 9.....2215

VOLUME VI

August 3, 2017, Vol 9 continued beginning page.....2426
Transcript of September 20, 2017 hearing on post-trial motions;.....2444

TRIAL EXHIBITS
Plaintiff Exhibit 102 —1934 Transactions of the National Safety Council.....2521
Plaintiff Exhibit 149 — Walsh-Healey Public Contracts Act.....2539
Plaintiff Exhibit 155 — Federal Register, Vol. 37 No. 110,
Rules and Regulations.....2571
Plaintiff Exhibit 160 —NIOSH Revised Asbestos Standard.....2576
Plaintiff Exhibit 929 — CV of Arnold R. Brody, Ph.D.....2677
Plaintiff Exhibit 936.1 — CV of Arthur L. Frank, M.D., Ph.D.....2705

VOLUME VII

Plaintiff Exhibit 936.2—Affidavit of Arthur L. Frank, M.D., Ph.D.....2734

VOLUME VIII

Plaintiff Exhibit 936.2 — continued beginning page.....2927
Plaintiff Exhibit 940 — Fisher Invoices — Catawba.....2950
Plaintiff Exhibit 945.3219 — Instructions for the Operation and Maintenance of Crosby
Safety Valves.....3309
Plaintiff Exhibit 948 — Fisher Controls Valve Handbook, Second Edition.....3317

VOLUME IX

Plaintiff Exhibit 948 — continued beginning page.....3427
Plaintiff Exhibit 972 — CV of Dr. John Coulter Maddox.....3526
Plaintiff Exhibit 1008 Asbestos Elimination Project, Fisher Governor.....3529
Plaintiff Exhibit 1008.1964 — Fisher Material Specification FMS 17AG.....3572
Plaintiff Exhibit 1008.10670 — Letter from Paul Adams to Fisher
University Hygienic Lab 7/11/90.....3579
Plaintiffs Exhibit 1008.10665 — Letter from Paul Adams at Fisher dated 7/9/80 to
University Hygienic Lab.....3580
Plaintiff Exhibit 1012 — Fisher Invoices.....3586
Plaintiff Exhibit 1012.2 — Duke P.O dated 9/3/92 to Fisher Controls.....3870
Plaintiff Exhibit 1012.3 — Duke PO dated 3/24/93 to Fisher Controls.....3874
Plaintiff Exhibit 1012.4 — Duke PO dated 5/19/93 to Fisher Controls.....3881

Plaintiff Exhibit 1012.5 — Mill Power Supply PO #H23395-73, 5/24/82 to Fisher Controls 3886
Plaintiff Exhibit 1012.6 — PO #K022828 dated 3/6/91 from Fisher Controls to Duke 3892
Plaintiff Exhibit 1012.7 — Mill Power Supply PO #M4988-73, 9/10/85 to Fisher Controls 3900
Plaintiff Exhibit 2006.037 — Fisher Governor material specification — high temperature packing 3904

VOLUME X

Plaintiff Exhibit 6359 3905
Plaintiff Exhibit 6364.01 — Invoice No. 26348 6/22/73 from Crosby to Duke Power Oconee 3944
Plaintiff Exhibit 6364.02 — Invoice No. 27798 9/3/73 from Crosby to Duke Power Oconee 3945
Plaintiff Exhibit 6364.03 — Mill Power Supply PO #82782, 3/22/74 to Crosby 3947
Plaintiff Exhibit 6364.04 — Mill Power Supply PO #H34069-73, 8/16/82 to Crosby 3948
Plaintiff Exhibit 6364.05 — Photocopy of photograph of Crosby valve 3954
Plaintiff Exhibit 6364.06 — Spreadsheet of Crosby valves 3955
Plaintiff Exhibit 6395 — Duke Crosby Invoices 3962
Crosby Exhibit 533 — cover page and page 3 only — Oury, Pathology of Asbestos-Associated Diseases, Third Ed 4326
Crosby Exhibit 134 — Duke Power Company, "Safe Working Practices When Working with Asbestos" (1977) 4328
Crosby Exhibit 135 — Duke Power Company, "Safe Working Practices for Asbestos Exposure" (1982) 4335
Crosby Exhibit 136 — Duke Power Company, "Asbestos: How to Protect Yourself" (1984); 4347
Crosby Exhibit 152 — OSHA - Federal Register Title 29 4363

OTHER MOTIONS AND MISCELLANEOUS:

Fisher and Crosby's Joint Motion *in Limine* 1(P) to Exclude Plaintiffs' Experts from Testifying That Every Exposure Contributes to Disease filed July 7, 2017, and the following attached exhibit: 4371
Exhibit A — Dr. Maddox Report 4386

Fisher and Crosby's Joint Motion *in Limine* 1(J) to Exclude Expert Testimony of Dr. John Maddox and Dr. Arthur Frank filed July 13, 2017 4390

VOLUME XI

Plaintiffs' Consolidated Response to Defendants' Motions to Exclude the Causation Testimony of Plaintiffs' Expert Witnesses, filed July 13, 2017 with exhibits: 4401

Exhibit 15 – *Concensus Report: Asbestos, asbestosis, and cancer: the Helsinki criteria for diagnosis and attribution* (1997).....4430
Exhibit 16 - *Concensus Report: Asbestos, asbestosis, and cancer: the Helsinki criteria for diagnosis and attribution* (2014).....4437
Exhibit 17 – *Guide for Ship Scrappers: Tips for Regulatory Compliance* (Summer 2000).....4449
Exhibit 18 – OSHA Website, Safety and Health Topics: Asbestos https://www.osha.gov/SLTCasbestos, last visited 1/8/14....4460
Exhibit 19 – IRAC Monographs on the Evaluation of Carcinogenic Risks to Humans.....4463
Exhibit 20 – National Cancer Institute Mesothelioma Fact Sheet.....4466
Exhibit 21 – National Cancer Institute Asbestos Exposure Fact Sheet.....4470
Exhibit 23 – American Cancer Society: Asbestos 4479
Exhibit 24 – WHO Air Quality Guidelines, Chapter 6.2 Asbestos 4486
Exhibit 25 – CPSC Ban of Consumer Patching Compounds Containing Respirable Free-Form Asbestos.....4501
Exhibit 26 – Landrigan, et al., *The Hazard of Chrysotile Asbestos: A Critical Review* (1999) 4504
Exhibit 27 – Hillerdal, *Mesothelioma: Cases Associated with Non-Occupational and Low Dose Exposure (1999)* 4515
Exhibit 28 – Welch, *Asbestos Exposure Causes Mesothelioma, But Not This Asbestos Exposure: an Amicus Brief to the Michigan Supreme Court* (2007) 4525
Exhibit 29 – *Joyce Rost v. Ford Motor Company* (2015).....4536
Exhibit 30 – Iwatsubo, et al, *Pleural Mesothelioma: Dose Response Relation at Low Levels of Asbestos Exposure in a French Population based Case Control Study* (1998).....4579
Exhibit 31 – Rodelsperger et al., *Asbestos and Man-Made Vitreous Fibers As Risk Factors for Diffuse Malignant Mesothelioma: Results From a German Hospital Based Case Control Study* (2001) .4590
Exhibit 32 – Rolland, *Risk of pleural mesothelioma: A French population Based case control study* (2006) 4605
Exhibit 33 – A. Lacourt et al., *Occupational and non-occupational attributable risk of asbestos exposure for malignant pleural mesothelioma* (2014).....4608

Fisher's Motion to Quash Plaintiffs' Trial Subpoena filed July 20, 2017.....4619

Fisher's Memorandum in Support of Its Motion to Quash Plaintiffs' Trial Subpoena filed July 20, 2017, with the following attached exhibits: 4621
Exhibit A—Trial Subpoena.....4624
Exhibit B—Affidavit of Philip C. Reid 4630

Crosby's Motion to Quash Plaintiffs' Trial Subpoena filed July 20, 2017.....4631

Crosby's Memorandum in Support of Its Motion to Quash Plaintiffs' Trial Subpoena filed July 20, 2017, with the following attached exhibits: 4633
Exhibit A—Trial Subpoena 4637
Exhibit B—Affidavit of Robert J. Martin 4643

Plaintiffs' Response in Opposition to Fisher and Crosby's Motions to Quash Plaintiffs' Trial Subpoenas filed July 20, 2017 4644

Fisher and Crosby's Joint Motion to Reconsider the Oral Denial of Their Motion to Quash Plaintiffs' Trial Subpoena filed July 26, 2017 4652

Fisher and Crosby's Joint Motion for Directed Verdict filed July 31, 2017 4659

Plaintiffs' Motion for New Trial *Nisi Additur* filed August 11, 2017 4696

Fisher and Crosby's Joint Motion for Set-Off filed August 14, 2017 4758

Fisher and Crosby's Joint Motion for Production of Plaintiffs' Settlements and Payments With All Third Party Tortfeasors filed August 14, 2017 4765

Fisher and Crosby's Joint Motion for JNOV filed August 14, 2017 4770

Fisher and Crosby's Joint Memorandum in Support of Their Joint Motion for JNOV filed August 23, 2017 4773

Fisher and Crosby's Brief in Opposition to Plaintiffs' Motion for New Trial *Nisi Additur* filed September 6, 2017, with the following attached exhibit: 4804
Exhibit C—Case Summary 4818

Plaintiffs' Response in Opposition to Fisher and Crosby's Joint Motion for JNOV filed September 6, 2017 4823

Plaintiffs' Response in Opposition to Fisher and Crosby's Joint Motion for Production of Plaintiffs' Settlements and Payments With All Third-Party Tortfeasors filed September 6, 2017 4861

Plaintiffs' Response in Opposition to Fisher and Crosby's Joint Motion for Set-Off filed September 6, 2017 4866

Plaintiffs' Reply in Support of Their Motion for New Trial *Nisi Additur* filed September 11, 2017 4872

Fisher and Crosby's Joint Rule 59(e) Motion to Alter or Amend 4875

Fisher and Crosby's Objections to Proposed Order Drafted by Plaintiffs and Supplemental Memorandum in Support of Their Motions and in Opposition to New Trial *Nisi* Motion filed October 20, 2017 4880

Certificate of Counsel

Additional Fractional/Decimal Inch—Millimeter Equivalents

INCHES		MILLI-METERS	INCHES		MILLI-METERS	INCHES		MILLI-METERS
Fractions	Decimals		Fractions	Decimals		Fractions	Decimals	
	.00394	.1		.2	5.08		.44	11.176
	.00787	.2	13/64	.203125	5.1594		.45	11.430
	.01	.254		.21	5.334	29/64	.453125	11.5094
	.01181	.3	7/32	.21875	5.5562		.46	11.684
1/64	.015625	.3969		.22	5.588	15/32	.46875	11.9062
	.01575	.4		.23	5.842		.47	11.938
	.01969	.5	15/64	.234375	5.9531		.47244	12.0
	.02	.508		.23622	6.0		.48	12.192
	.02362	.6		.24	6.096	31/64	.484375	12.3031
	.02756	.7	1/4	.25	6.35		.49	12.446
	.03	.762		.26	6.604	1/2	.50	12.7
1/32	.03125	.7938	17/64	.265625	6.7469		.51	12.954
	.0315	.8		.27	6.858		.51181	13.0
	.03543	.9		.27559	7.0	33/64	.515625	13.0969
	.03937	1.0		.28	7.112		.52	13.208
	.04	1.016	9/32	.28125	7.1438		.53	13.462
3/64	.046875	1.1906		.29	7.366	17/32	.53125	13.4938
	.05	1.27	19/64	.296875	7.5406		.54	13.716
	.06	1.524		.30	7.62	35/64	.546875	13.8906
1/16	.0625	1.5875		.31	7.874		.55	13.970
	.07	1.778	5/16	.3125	7.9375		.55118	14.0
5/64	.078125	1.9844		.31496	8.0		.56	14.224
	.07874	2.0		.32	8.128	9/16	.5625	14.2875
	.08	2.032	21/64	.328125	8.3344		.57	14.478
	.09	2.286		.33	8.382	37/64	.578125	14.6844
3/32	.09375	2.3812		.34	8.636		.58	14.732
	.1	2.54	11/32	.34375	8.7312		.59	14.986
7/64	.109375	2.7781		.35	8.89		.59055	15.0
	.11	2.794		.35433	9.0	19/32	.59375	15.0812
	.11811	3.0	23/64	.359375	9.1281		.60	15.24
	.12	3.048		.36	9.144	39/64	.609375	15.4781
1/8	.125	3.175		.37	9.398		.61	15.494
	.13	3.302	3/8	.375	9.525		.62	15.748
	.14	3.556		.38	9.652	5/8	.625	15.875
9/64	.140625	3.5719		.39	9.906		.62992	16.0
	.15	3.810	25/64	.390625	9.9219		.63	16.002
5/32	.15625	3.9688		.39370	10.0		.64	16.256
	.15748	4.0		.40	10.16	41/64	.640625	16.2719
	.16	4.064	13/32	.40625	10.3188		.65	16.510
	.17	4.318		.41	10.414	21/32	.65625	16.6688
11/64	.171875	4.3656		.42	10.668		.66	16.764
	.18	4.572	27/64	.421875	10.7156		.66929	17.0
3/16	.1875	4.7625		.43	10.922		.67	17.018
	.19	4.826		.43307	11.0	43/64	.671875	17.0656
	.19685	5.0	7/16	.4375	11.1125		.68	17.272

- Continued -

Additional Fractional/Decimal Inch—Millimeter Equivalents (Continued)

INCHES		MILLI-METERS	INCHES		MILLI-METERS	INCHES		MILLI-METERS
Fractions	Decimals		Fractions	Decimals		Fractions	Decimals	
11/16	.6875	17.4625	51/64	.796875	20.2406		.90551	23.0
	.69	17.526		.80	20.320	29/32	.90625	23.0188
	.70	17.78		.81	20.574		.91	23.114
45/64	.703125	17.8594	13/16	.8125	20.6375		.92	23.368
	.70866	18.0		.82	20.828	59/64	.921875	23.4156
	.71	18.034		.82677	21.0		.93	23.622
23/32	.71875	18.2562	53/64	.828125	21.0344	15/16	.9375	23.8125
	.72	18.288		.83	21.082		.94	23.876
	.73	18.542		.84	21.336		.94488	24.0
47/64	.734375	18.6531	27/32	.84375	21.4312		.95	24.130
	74	18.796		.85	21.590	61/64	.953125	24.2094
	.74803	19.0	55/64	.859375	21.8281		.96	24.384
3/4	.75	19.050		.86	21.844	31/32	.96875	24.6062
	.76	19.304		.86614	22.0		.97	24.638
49/64	.765625	19.4469		.87	22.098		.98	24.892
	.77	19.558	7/8	.875	22.225		.98425	25.0
	.78	19.812		.88	22.352	63/64	.984375	25.0031
25/32	.78125	19.8438		.89	22.606		.99	25.146
	.78740	20.0	57/64	.890625	22.6219	1	1.00000	25.4000
	.79	20.066		.90	22.860			

Note: Round off decimal points to provide no more than the desired degree of accuracy.

Area Equivalents

To Obtain / by / Multiply Number of	Square Meters	Square Inches	Square Feet	Square Miles	Square Kilometers
Square Meters	1	1549.99	10.7639	3.861×10^{-7}	1×10^{-6}
Square Inches	0.0006452	1	6.944×10^{-3}	2.491×10^{-10}	6.452×10^{-10}
Square Feet	0.0929	144	1	3.587×10^{-8}	9.29×10^{-8}
Square Miles	2,589,999	...	27,878,400	1	2.59
Square Kilometers	1,000,000	...	10,763,867	0.3861	1

1 square meter = 10,000 square centimeters.
1 square millimeter = 0.01 square centimeter = 0.00155 square inches.

Volume Equivalents

To Obtain / by / Multiply Number of	Cubic Decimeters (Liters)	Cubic Inches	Cubic Feet	U.S. Quart	U.S. Gallon	Imperial Gallon	U.S. Barrel (Petroleum)
Cubic Decimeters (Liters)	1	61.0234	0.03531	1.05668	0.264178	0.220083	0.00629
Cubic Inches	0.01639	1	5.787×10^{-4}	0.01732	0.004329	0.003606	0.000103
Cubic Feet	28.317	1728	1	29.9221	7.48055	6.22888	0.1781
U.S. Quart	0.94636	57.75	0.03342	1	0.25	0.2082	0.00595
U.S. Gallon	3.78543	231	0.13368	4	1	0.833	0.02381
Imperial Gallon	4.54374	277.274	0.16054	4.80128	1.20032	1	0.02877
U.S. Barrel (Petroleum)	158.98	9702	5.6146	168	42	34.973	1

1 cubic meter = 1,000,000 cubic centimeters.
1 liter = 1000 milliliters = 1000 cubic centimeters.

Volume Rate Equivalents

To Obtain / by / Multiply Number of	Liters Per Minute	Cubic Meters Per Hour	Cubic Feet Per Hour	Liters Per Hour	U.S. Gallon Per Minute	U.S. Barrel Per Day
Liters Minute	1	0.06	2.1189	60	0.264178	9.057
Cubic Meters Per Hour	16.667	1	35.314	1000	4.403	151
Cubic Feet Per Hour	0.4719	0.028317	1	28.317	0.1247	4.2746
Liters Per Hour	0.016667	0.001	0.035314	1	0.004403	0.151
U.S. Gallon Per Minute	3.785	0.2273	8.0208	227.3	1	34.28
U.S. Barrel Per Day	0.1104	0.006624	0.23394	6.624	0.02917	1

Pressure Equivalents

Multiply Number of / To Obtain by	Kg. Per Sq. Cm.	Lb. Per Sq. In.	Atm.	Bar	In. of Hg.	Kilopascals	In. of Water	Ft. of Water
Kg. Per Sq. Cm.	1	14.22	0.9678	0.98067	28.96	98.067	394.06	32.84
Lb. Per Sq. In.	0.07031	1	0.06804	0.06895	2.036	6.895	27.7	2.309
Atm.	1.0332	14.696	1	1.01325	29.92	101.325	407.14	33.93
Bar	1.01972	14.5038	0.98692	1	29.53	100	402.156	33.513
In. of Hg.	0.03453	0.4912	0.03342	0.033864	1	3.3864	13.61	1.134
Kilopascals	0.0101972	0.145038	0.0098696	0.01	0.2953	1	4.02156	0.33513
In. of Water	0.002538	0.0361	0.002456	0.00249	0.07349	0.249	1	0.0833
Ft. of Water	0.03045	0.4332	0.02947	0.029839	0.8819	2.9839	12	1

1 ounce/sq. inch = 0.0625 lbs./sq. inch.

Mass Conversion—Pounds to Kilograms

(1 pound = 0.4536 kilogram)

Pounds	0	1	2	3	4	5	6	7	8	9
	Kilograms									
0	0.00	0.45	0.91	1.36	1.81	2.27	2.72	3.18	3.63	4.08
10	4.54	4.99	5.44	5.90	6.35	6.80	7.26	7.71	8.16	8.62
20	9.07	9.53	9.98	10.43	10.89	11.34	11.79	12.25	12.70	13.15
30	13.61	14.06	14.52	14.97	15.42	15.88	16.33	16.78	17.24	17.69
40	18.14	18.60	19.05	19.50	19.96	20.41	20.87	21.32	21.77	22.23
50	22.68	23.13	23.59	24.04	24.49	24.95	25.40	25.86	26.31	26.76
60	27.22	27.67	28.12	28.58	29.03	29.48	29.94	30.39	30.84	31.30
70	31.75	32.21	32.66	33.11	33.57	34.02	34.47	34.93	35.38	35.83
80	36.29	36.74	37.20	37.65	38.10	38.56	39.01	39.46	39.92	40.37
90	40.82	41.28	41.73	42.18	42.64	43.09	43.55	44.00	44.45	44.91

calafish_00197

Pressure Conversion—Pounds per Square Inch to Bar*

Pounds Per Square Inch	0	1	2	3	4	5	6	7	8	9
	Bar									
0	0.000000	0.068948	0.137895	0.206843	0.275790	0.344738	0.413685	0.482633	0.551581	0.620528
10	0.689476	0.758423	0.827371	0.896318	0.965266	1.034214	1.103161	1.172109	1.241056	1.310004
20	1.378951	1.447899	1.516847	1.585794	1.654742	1.723689	1.792637	1.861584	1.930532	1.999480
30	2.068427	2.137375	2.206322	2.275270	2.344217	2.413165	2.482113	2.551060	2.620008	2.688955
40	2.757903	2.826850	2.895798	2.964746	3.033693	3.102641	3.171588	3.240536	3.309484	3.378431
50	3.447379	3.516326	3.585274	3.654221	3.723169	3.792117	3.861064	3.930012	3.998959	4.067907
60	4.136854	4.205802	4.274750	4.343697	4.412645	4.481592	4.550540	4.619487	4.688435	4.757383
70	4.826330	4.895278	4.964225	5.033173	5.102120	5.171068	5.240016	5.308963	5.377911	5.446858
80	5.515806	5.584753	5.653701	5.722649	5.791596	5.860544	5.929491	5.998439	6.067386	6.136334
90	6.205282	6.274229	6.343177	6.412124	6.481072	6.550019	6.618967	6.687915	6.756862	6.825810
100	6.894757	6.963705	7.032652	7.101600	7.170548	7.239495	7.308443	7.377390	7.446338	7.515286

*To convert to kilopascals, move decimal point two positions to right; to convert to Megapascals, move decimal point one position to left. For example, 30 psi = 2.068427 bar = 206.8427 kPa = 0.2068427 MPa.

Note: Round off decimal points to provide no more than the desired degree of accuracy.

calafish_00198

ROA_03431

Temperature Conversion Tables

Temperature Conversion Formulas

To Convert From	To	Substitute in Formula
Degrees Celsius	Degrees Fahrenheit	(°C x 9/5) + 32
Degrees Celsius	Kelvin	(°C + 273.16)
Degrees Fahrenheit	Degrees Celsius	(°F −32) x 5/9
Degrees Fahrenheit	Degrees Rankin	(°F + 459.69)

Temperature Conversions

°C	Temp. in °C or °F to be Converted	°F	°C	Temp. in °C or °F to be Converted	°F	°C	Temp. in °C or °F to be Converted	°F
−273.16	−459.69		−90.00	−130	−202.0	−17.8	0	32.0
−267.78	−450		−84.44	−120	−184.0	−16.7	2	35.6
−262.22	−440		−78.89	−110	−166.0	−15.6	4	39.2
−256.67	−430		−73.33	−100	−148.0	−14.4	6	42.8
−251.11	−420		−70.56	−95	−139.0	−13.3	8	46.4
−245.56	−410		−67.78	−90	−130.0	−12.2	10	50.0
−240.00	−400		−65.00	−85	−121.0	−11.1	12	53.6
−234.44	−390		−62.22	−80	−112.0	−10.0	14	57.2
−228.89	−380		−59.45	−75	−103.0	−8.89	16	60.8
−223.33	−370		−56.67	−70	−94.0	−7.78	18	64.4
−217.78	−360		−53.89	−65	−85.0	−6.67	20	68.0
−212.22	−350		−51.11	−60	−76.0	−5.56	22	71.6
−206.67	−340		−48.34	−55	−67.0	−4.44	24	75.2
−201.11	−330		−45.56	−50	−58.0	−3.33	26	78.8
−195.56	−320		−42.78	−45	−49.0	−2.22	28	82.4
−190.00	−310		−40.00	−40	−40.0	−1.11	30	86.0
−184.44	−300		−38.89	−38	−36.4	0	32	89.6
−178.89	−290		−37.78	−36	−32.8	1.11	34	93.2
−173.33	−280		−36.67	−34	−29.2	2.22	36	96.8
−169.53	−273.16	−459.69	−35.56	−32	−25.6	3.33	38	100.4
−168.89	−272	−457.6	−34.44	−30	−22.0	4.44	40	104.0
−167.78	−270	−454.0	−33.33	−28	−18.4	5.56	42	107.6
−162.22	−260	−436.0	−32.22	−26	−14.8	6.67	44	111.2
−156.67	−250	−418.0	−31.11	−24	−11.2	7.78	46	114.8
−151.11	−240	−400.0	−30.00	−22	−7.6	8.89	48	118.4
−145.56	−230	−382.0	−28.89	−20	−4.0	10.0	50	122.0
−140.00	−220	−364.0	−27.78	−18	−0.4	11.1	52	125.6
−134.44	−210	−346.0	−26.67	−16	3.2	12.2	54	129.2
−128.89	−200	−328.0	−25.56	−14	6.8	13.3	56	132.8
−123.33	−190	−310.0	−24.44	−12	10.4	14.4	58	136.4
−117.78	−180	−292.0	−23.33	−10	14.0	15.6	60	140.0
−112.22	−170	−274.0	−22.22	−8	17.6	16.7	62	143.6
−106.67	−160	−256.0	−21.11	−6	21.2	17.8	64	147.2
−101.11	−150	−238.0	−20.00	−4	24.8	18.9	66	150.8
−95.56	−140	−220.0	−18.89	−2	28.4	20.0	68	154.4

- Continued -

Temperature Conversions (Continued)

°C	Temp. in °C or °F to be Converted	°F	°C	Temp. in °C or °F to be Converted	°F	°C	Temp. in °C or °F to be Converted	°F
21.1	70	158.0	204.4	400	752.0	454.4	850	1562.0
22.2	72	161.6	210.0	410	770.0	460.0	860	1580.0
23.3	74	165.2	215.6	420	788.0	465.6	870	1598.0
24.4	76	168.8	221.1	430	806.0	471.1	880	1616.0
25.6	78	172.4	226.7	440	824.0	476.7	890	1634.0
26.7	80	176.0	232.2	450	842.0	482.2	900	1652.0
27.8	82	179.6	237.8	460	860.0	487.8	910	1670.0
28.9	84	183.2	243.3	470	878.0	493.3	920	1688.0
30.0	86	186.8	248.9	480	896.0	498.9	930	1706.0
31.1	88	190.4	254.4	490	914.0	504.4	940	1724.0
32.2	90	194.0	260.0	500	932.0	510.0	950	1742.0
33.3	92	197.6	265.6	510	950.0	515.6	960	1760.0
34.4	94	201.2	271.1	520	968.0	521.1	970	1778.0
35.6	96	204.8	276.7	530	986.0	526.7	980	1796.0
36.7	98	208.4	282.2	540	1004.0	532.2	990	1814.0
37.8	100	212.0	287.8	550	1022.0	537.8	1000	1832.0
43.3	110	230.0	293.3	560	1040.0	543.3	1010	1850.0
48.9	120	248.0	298.9	570	1058.0	548.9	1020	1868.0
54.4	130	266.0	304.4	580	1076.0	554.4	1030	1886.0
60.0	140	284.0	310.0	590	1094.0	560.0	1040	1904.0
65.6	150	302.0	315.6	600	1112.0	565.6	1050	1922.0
71.1	160	320.0	321.1	610	1130.0	571.1	1060	1940.0
76.7	170	338.0	326.7	620	1148.0	576.7	1070	1958.0
82.2	180	356.0	332.2	630	1166.0	582.2	1080	1976.0
87.8	190	374.0	337.8	640	1184.0	587.8	1090	1994.0
93.3	200	392.0	343.3	650	1202.0	593.3	1100	2012.0
98.9	210	410.0	348.9	660	1220.0	598.9	1110	2030.0
104.4	220	428.0	354.4	670	1238.0	604.4	1120	2048.0
110.0	230	446.0	360.0	680	1256.0	610.0	1130	2066.0
115.6	240	464.0	365.6	690	1274.0	615.6	1140	2084.0
121.1	250	482.0	371.1	700	1292.0	621.1	1150	2102.0
126.7	260	500.0	376.7	710	1310.0	626.7	1160	2120.0
132.2	270	518.0	382.2	720	1328.0	632.2	1170	2138.0
137.8	280	536.0	387.8	730	1346.0	637.8	1180	2156.0
143.3	290	554.0	393.3	740	1364.0	643.3	1190	2174.0
148.9	300	572.0	398.9	750	1382.0	648.9	1200	2192.0
154.4	310	590.0	404.4	760	1400.0	654.4	1210	2210.0
160.0	320	608.0	410.0	770	1418.0	660.0	1220	2228.0
165.6	330	626.0	415.6	780	1436.0	665.6	1230	2246.0
171.1	340	644.0	421.1	790	1454.0	671.1	1240	2264.0
176.7	350	662.0	426.7	800	1472.0	676.7	1250	2282.0
182.2	360	680.0	432.2	810	1490.0	682.2	1260	2300.0
187.8	370	698.0	437.8	820	1508.0	687.8	1270	2318.0
193.3	380	716.0	443.3	830	1526.0	693.3	1280	2336.0
198.9	390	734.0	448.9	840	1544.0	698.9	1290	2354.0

- Continued -

Temperature Conversions (Continued)

°C	Temp. in °C or °F to be Converted	°F	°C	Temp. in °C or °F to be Converted	°F	°C	Temp. in °C or °F to be Converted	°F
704.4	1300	2372.0	760.0	1400	2552.0	815.6	1500	2732.0
710.0	1310	2390.0	765.6	1410	2570.0			
715.6	1320	2408.0	771.1	1420	2588.0			
721.1	1330	2426.0	776.7	1430	2606.0			
726.7	1340	2444.0	782.2	1440	2624.0			
732.2	1350	2462.0	787.0	1450	2642.0			
737.8	1360	2480.0	793.3	1460	2660.0			
743.3	1370	2498.0	798.9	1470	2678.0			
748.9	1380	2516.0	804.4	1480	2696.0			
754.4	1390	2634.0	810.0	1490	2714.0			

A.P.I. and Baumé Gravity Tables and Weight Factors

A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lb/ U.S. Gal	U.S. Gal/ Lb	A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lb/ U.S. Gal	U.S. Gal/ Lb
0	10.247	1.0760	8.962	0.1116					
1	9.223	1.0679	8.895	0.1124	31	30.78	0.8708	7.251	0.1379
2	8.198	1.0599	8.828	0.1133	32	31.77	0.8654	7.206	0.1388
3	7.173	1.0520	8.762	0.1141	33	32.76	0.8602	7.163	0.1396
4	6.148	1.0443	8.698	0.1150	34	33.75	0.8550	7.119	0.1405
5	5.124	1.0366	8.634	0.1158	35	34.73	0.8498	7.076	0.1413
6	4.099	1.0291	8.571	0.1167	36	35.72	0.8448	7.034	0.1422
7	3.074	1.0217	8.509	0.1175	37	36.71	0.8398	6.993	0.1430
8	2.049	1.0143	8.448	0.1184	38	37.70	0.8348	6.951	0.1439
9	1.025	1.0071	8.388	0.1192	39	38.69	0.8299	6.910	0.1447
10	10.00	1.0000	8.328	0.1201	40	39.68	0.8251	6.870	0.1456
11	10.99	0.9930	8.270	0.1209	41	40.67	0.8203	6.830	0.1464
12	11.98	0.9861	8.212	0.1218	42	41.66	0.8155	6.790	0.1473
13	12.97	0.9792	8.155	0.1226	43	42.65	0.8109	6.752	0.1481
14	13.96	0.9725	8.099	0.1235	44	43.64	0.8063	6.713	0.1490
15	14.95	0.9659	8.044	0.1243	45	44.63	0.8017	6.675	0.1498
16	15.94	0.9593	7.989	0.1252	46	45.62	0.7972	6.637	0.1507
17	16.93	0.9529	7.935	0.1260	47	50.61	0.7927	6.600	0.1515
18	17.92	0.9465	7.882	0.1269	48	50.60	0.7883	6.563	0.1524
19	18.90	0.9402	7.830	0.1277	49	50.59	0.7839	6.526	0.1532
20	19.89	0.9340	7.778	0.1286	50	50.58	0.7796	6.490	0.1541
21	20.88	0.9279	7.727	0.1294	51	50.57	0.7753	6.455	0.1549
22	21.87	0.9218	7.676	0.1303	52	51.55	0.7711	6.420	0.1558
23	22.86	0.9159	7.627	0.1311	53	52.54	0.7669	6.385	0.1566
24	23.85	0.9100	7.578	0.1320	54	53.53	0.7628	6.350	0.1575
25	24.84	0.9042	7.529	0.1328	55	54.52	0.7587	6.316	0.1583
26	25.83	0.8984	7.481	0.1337	56	55.51	0.7547	6.283	0.1592
27	26.82	0.8927	7.434	0.1345	57	56.50	0.7507	6.249	0.1600
28	27.81	0.8871	7.387	0.1354	58	57.49	0.7467	6.216	0.1609
29	28.80	0.8816	7.341	0.1362	59	58.48	0.7428	6.184	0.1617
30	29.79	0.8762	7.296	0.1371	60	59.47	0.7389	6.151	0.1626

- Continued -

A.P.I. and Baumé Gravity Tables and Weight Factors (Continued)

A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lb/ U.S. Gal	U.S. Gal/ Lb	A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lb/ U.S. Gal	U.S. Gal/ Lb
61	60.46	0.7351	6.119	0.1634	81	80.25	0.6659	5.542	0.1804
62	61.45	0.7313	6.087	0.1643	82	81.24	0.6628	5.516	0.1813
63	62.44	0.7275	6.056	0.1651	83	82.23	0.6597	5.491	0.1821
64	63.43	0.7238	6.025	0.1660	84	83.22	0.6566	5.465	0.1830
65	64.42	0.7201	6.994	0.1668	85	84.20	0.6536	5.440	0.1838
66	65.41	0.7165	5.964	0.1677	86	85.19	0.6506	5.415	0.1847
67	66.40	0.7128	5.934	0.1685	87	86.18	0.6476	5.390	0.1855
68	67.39	0.7093	5.904	0.1694	88	87.17	0.6446	5.365	0.1864
69	68.37	0.7057	5.874	0.1702	89	88.16	0.6417	5.341	0.1872
70	69.36	0.7022	5.845	0.1711	90	89.15	0.6388	5.316	0.1881
71	70.35	0.6988	5.817	0.1719	91	90.14	0.6360	5.293	0.1889
72	71.34	0.6953	5.788	0.1728	92	91.13	0.6331	5.269	0.1898
73	72.33	0.6919	5.759	0.1736	93	92.12	0.6303	5.246	0.1906
74	73.32	0.6886	5.731	0.1745	94	93.11	0.6275	5.222	0.1915
75	74.31	0.6852	5.703	0.1753	95	94.10	0.6247	5.199	0.1924
76	75.30	0.6819	5.676	0.1762	96	95.09	0.6220	5.176	0.1932
77	76.29	0.6787	5.649	0.1770	97	96.08	0.6193	5.154	0.1940
78	77.28	0.6754	5.622	0.1779	98	97.07	0.6166	5.131	0.1949
79	78.27	0.6722	5.595	0.1787	99	98.06	0.6139	5.109	0.1957
80	79.26	0.6690	5.568	0.1796	100	99.05	0.6112	5.086	0.1966

The relation of Degrees Baumé or A.P.I. to Specific Gravity is expressed by the following formulas:

For liquids lighter than water:

$$\text{Degrees Baumé} = \frac{140}{G} - 130, \quad G = \frac{140}{130 + \text{Degrees Baumé}}$$

$$\text{Degrees A.P.I.} = \frac{141.5}{G} - 131.5, \quad G = \frac{141.5}{131.5 + \text{Degrees A.P.I.}}$$

For liquids heavier than water:

$$\text{Degrees Baumé} = 145 - \frac{145}{G}, \quad G = \frac{145}{145 - \text{Degrees Baumé}}$$

G = Specific Gravity = ratio of the weight of a given volume of oil at 60° Fahrenheit to the weight of the same volume of water at 60° Fahrenheit.

The above tables are based on the weight of 1 gallon (U.S.) of oil with a volume of 231 cubic inches at 60° Fahrenheit in air at 760 mm pressure and 50% humidity. Assumed weight of 1 gallon of water at 60° Fahrenheit in air is 8.32828 pounds.

To determine the resulting gravity by mixing oils of different gravities:

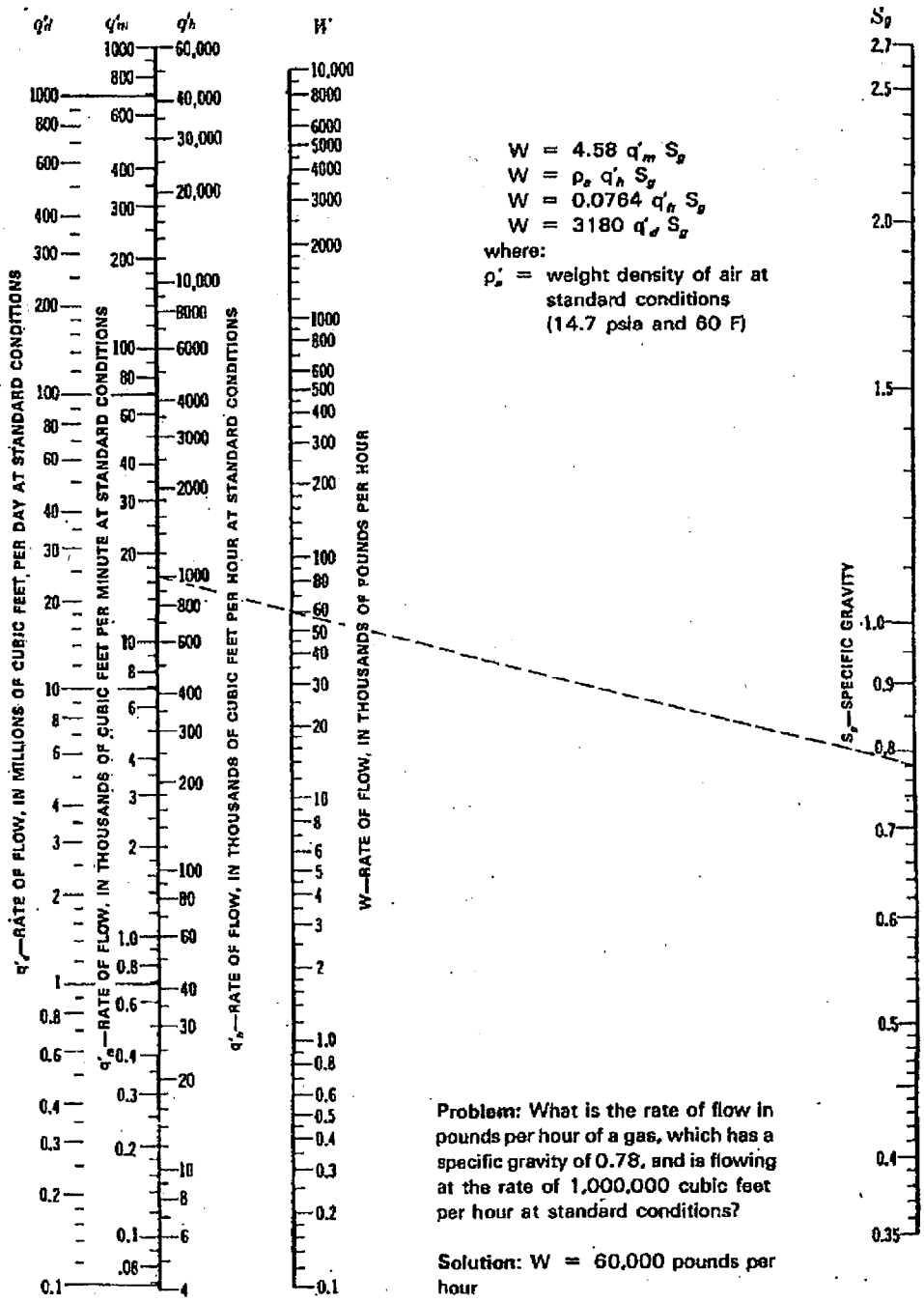
$$D = \frac{md_1 + nd_2}{m + n}$$

D = Density or Specific Gravity of mixture
m = Proportion of oil of d_1 density
n = Proportion of oil of d_2 density
d_1 = Specific Gravity of m oil
d_2 = Specific Gravity of n oil

calafish_00202

ROA_03435

Equivalent Volume and Weight Flow Rates of Compressible Fluids



$W = 4.58\ q'_m\ S_g$
$W = \rho_a\ q'_h\ S_g$
$W = 0.0764\ q'_h\ S_g$
$W = 3180\ q'_d\ S_g$

where:

ρ'_a = weight density of air at standard conditions (14.7 psia and 60 F)

Problem: What is the rate of flow in pounds per hour of a gas, which has a specific gravity of 0.78, and is flowing at the rate of 1,000,000 cubic feet per hour at standard conditions?

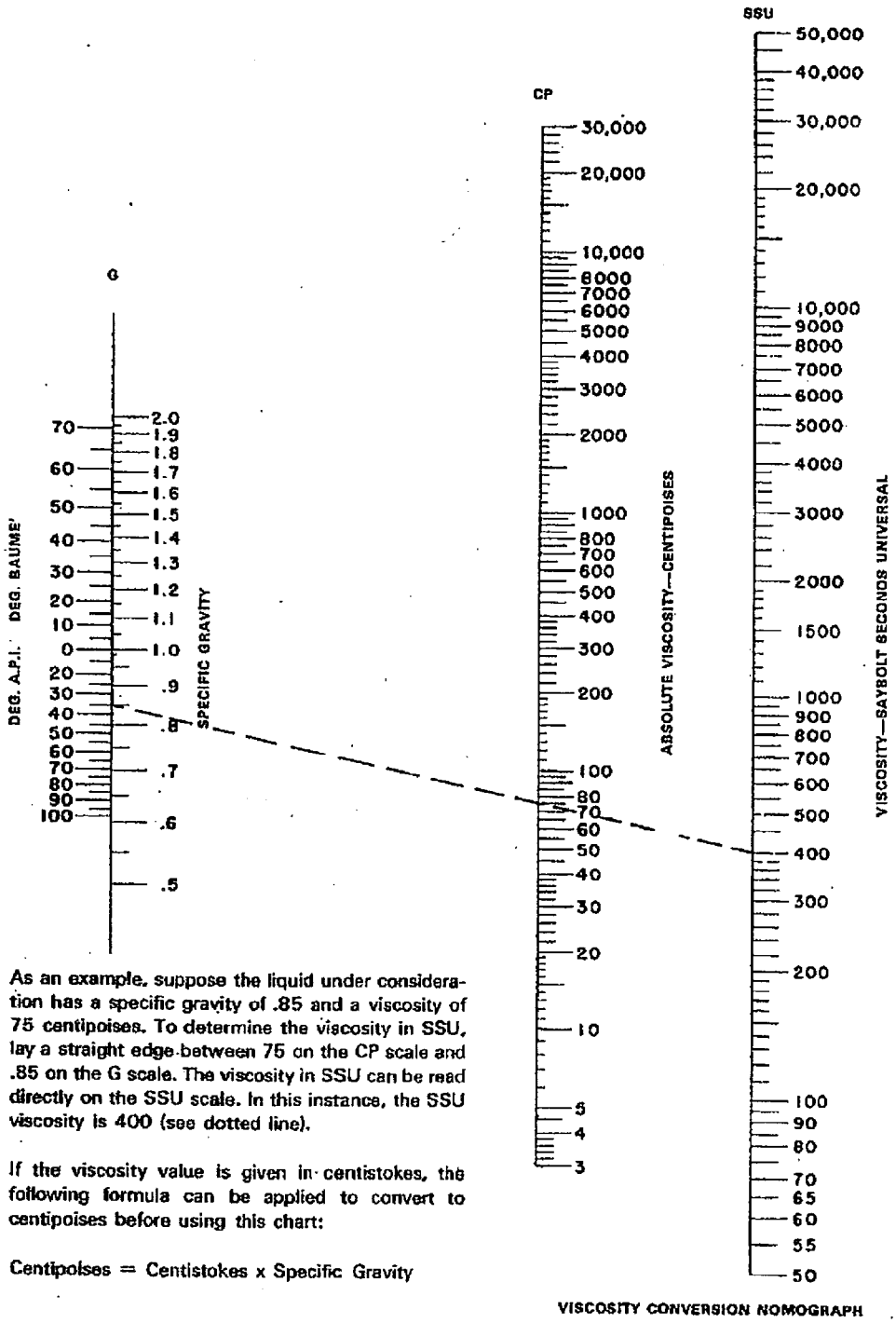
Solution: W = 60,000 pounds per hour

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00203

ROA_03436

Viscosity Conversion Nomograph



VISCOSITY CONVERSION NOMOGRAPH

As an example, suppose the liquid under consideration has a specific gravity of .85 and a viscosity of 75 centipoises. To determine the viscosity in SSU, lay a straight edge between 75 on the CP scale and .85 on the G scale. The viscosity in SSU can be read directly on the SSU scale. In this instance, the SSU viscosity is 400 (see dotted line).

If the viscosity value is given in centistokes, the following formula can be applied to convert to centipoises before using this chart:

Centipoises = Centistokes x Specific Gravity

Other Useful Conversions

To Convert From	To	Multiply By
Cu Ft (Methane)	B.T.U.	1000 (approx.)
Cu Ft of Water	Lbs of Water	62.4
Degrees	Radians	0.01745
Gals	Lbs of Water	8.336
Grams	Ounces	0.0352
Horsepower (mech.)	Ft Lbs per Min	33,000
Horsepower (elec.)	Watts	746
Kg	Lbs	2.205
Kg per Cu Meter	Lbs per Cu Ft	0.06243
Kilowatts	Horsepower	1.341
Lbs	Kg	0.4536
Lbs of Air (14.7 psia and 60° F)	Cu Ft of Air	13.1
Lbs per Cu Ft	Kg per Cu Meter	16.0184
Lbs per Hr (Gas)	Std Cu Ft per Hr	$\frac{13.1}{\text{Specific Gravity}}$
Lbs per Hr (Water)	Gals per Min	0.002
Lbs per Sec (Gas)	Std Cu Ft per Hr	$\frac{46,160}{\text{Specific Gravity}}$
Radians	Degrees	57.3
Scfh Air	Scfh Propane	0.81
Scfh Air	Scfh Butane	0.71
Scfh Air	Scfh 0.6 Natural Gas	1.29
Scfh	Cu Meters per Hr	0.028317

Section 7

Engineering Data

Characteristics of the Elements

Element	Symbol	Atomic Number	Mass Number*	Melting Point (°C)	Boiling Point (°C)
actinium	Ac	89	(227)	1600†	
aluminum	Al	13	27	659.7	2057
americium	Am	95	(243)		
antimony (stibium)	Sb	51	121	630.5	1380
argon	Ar	18	40	−189.2	−185.7
arsenic	As	33	75	sublimes at 615	
astatine	At	85	(210)		
barium	Ba	56	138	850	1140
berkelium	Bk	97	(247)		
beryllium	Be	4	9	1278±5	2970
bismuth	Bi	83	209	271.3	1560±5
boron	B	5	11	2300	2550
bromine	Br	35	79	−7.2	58.78
cadmium	Cd	48	114	320.9	767±2
calcium	Ca	20	40	842±8	1240
californium	Cf	98	(249)		
carbon	C	6	12	>3550	4200
cerium	Ce	58	140	804	1400
cesium	Cs	55	133	28.5	670
chlorine	Cl	17	35	−103±5	−34.6
chromium	Cr	24	52	1890	2480
cobalt	Co	27	59	1495	2900
copper	Cu	29	63	1083	2336
curium	Cm	96	(248)		
dysprosium	Dy	66	164		

*Mass number shown is that of the stable isotope most common in nature. Mass numbers shown in parentheses designate the isotope with the longest half-life (slowest rate of radio-active decay) for those elements having no stable isotope.
†Calculated.
>Greater than.

- Continued -

Characteristics of the Elements (Continued)

Element	Symbol	Atomic Number	Mass Number*	Melting Point (°C)	Boiling Point (°C)
einsteinium	Es	99	(254)		
erbium	Er	68	166		
europium	Eu	63	153	1150±50	
fermium	Fm	100	(252)		
fluorine	F	9	19	−223	−188
francium	Fr	87	(223)		
gadolinium	Gd	64	158		
gallium	Ga	31	69	29.78	1983
germanium	Ge	32	74	958.5	2700
gold	Au	79	197	1063	2600
hafnium	Hf	72	180	1700†	>3200
helium	He	2	4	−272	−268.9
holmium	Ho	67	165		
hydrogen	H	1	1	−259.14	−252.8
indium	In	49	115	156.4	2000±10
iodine	I	53	127	113.7	184.35
iridium	Ir	77	193	2454	>4800
iron	Fe	26	56	1535	3000
krypton	Kr	36	84	−156.6	−152.9
lanthanum	La	57	139	826	
lawrencium	Lw	103	(257)		
lead	Pb	82	208	327.43	1620
lithium	Li	3	7	186	1336±5
lutetium	Lu	71	175		
magnesium	Mg	12	24	651	1107
manganese	Mn	25	55	1260	1900
mendelevium	Mv	101	(256)		
mercury	Hg	80	202	−38.87	356.58
molybdenum	Mo	42	98	2620±10	4800
neodymium	Nd	60	142	840	
neon	Ne	10	20	−248.67	−245.9
neptunium	Np	93	(237)		
nickel	Ni	28	58	1455	2900
niobium	Nb	41	93	2500±50	3700
nitrogen	N	7	14	−209.86	−195.8
nobelium	No	102	(253)		
osmium	Os	76	192	2700	>5300
oxygen	O	8	16	−218.4	−182.86
palladium	Pd	46	106	1549.4	2000
phosphorus	P	15	31		
platinum	Pt	78	195	1773.5	4300
plutonium	Pu	94	(242)		
polonium	Po	84	(209)		
potassium	K	19	39	63.3	760
praseodymium	Pr	59	141	940	
promethium	Pm	61	(145)		
protactinium	Pa	91	(231)		
radium	Ra	88	(226)	700	1140
radon	Rn	86	(222)	−71	−61.8
rhenium	Re	75	187	3167±60	

*Mass number shown is that of the stable isotope most common in nature. Mass numbers shown in parentheses designate the isotope with the longest half-life (slowest rate of radio-active decay) for those elements having no stable isotope.
†Calculated.
>Greater than.

- Continued -

calafish_00207

ROA_03440

Characteristics of the Elements (Continued)

Element	Symbol	Atomic Number	Mass Number*	Melting Point (°C)	Boiling Point (°C)
rhodium	Rh	45	103	1966±3	>2500
rubidium	Rb	37	85	38.5	700
ruthenium	Ru	44	102	2450	2700
samarium	Sm	62	152	>1300	
scandium	Sc	21	45	1200	2400
selenium	Se	34	80	217	688
silicon	Si	14	28	1420	2355
silver	Ag	47	107	960.8	1950
sodium	Na	11	23	97.5	880
strontium	Sr	38	88	800	1150
sulfur	S	16	32		
tantalum	Ta	73	180	2996±50	c.4100
technetium	Tc	43	(99)		
tellurium	Te	52	130	452	1390
terbium	Tb	65	159	327±5	
thallium	Tl	81	205	302	1457±10
thorium	Th	90	232	1845	4500
thulium	Tm	69	169		
tin	Sn	50	120	231.89	2270
titanium	Ti	22	48	1800	>3000
tungsten (wolfram)	W	74	184	3370	5900
uranium	U	92	238	c.1133	
vanadium	V	23	51	1710	3000
xenon	Xe	54	132	−112	−107.1
ytterbium	Yb	70	174	1800	
yttrium	Y	39	89	1490	2500
zinc	Zn	30	64	419.47	907
zirconium	Zr	40	90	1857	>2900

*Mass number shown is that of the stable isotope most common in nature. Mass numbers shown in parentheses designate the isotope with the longest half-life (slowest rate of radio-active decay) for those elements having no stable isotope.
†Calculated.
>Greater than.

Recommended Standard Specifications for Valve Materials

Pressure-Containing Castings

(1) Carbon Steel
ASTM A216 Grade WCB

Temp. range = −20°F to 1000°F
Composition (Percent)
C 0.30 max
Mn 1.00 max
P 0.05 max
S 0.06 max
Si 0.60 max

(2) Carbon Steel
ASTM A352 Grade LCB

Temp. range = −50°F to 650°F
Composition: Same as ASTM A216 Grade WCB

(3) Chrome Moly Steel
ASTM A217 Grade C5

Temp. range = −20°F to 1100°F
Composition (Percent)
C 0.20 max
Mn 0.40 to 0.70
P 0.05 max
S 0.06 max
Si 0.75 max
Cr 4.00 to 6.50
Mo 0.45 to 0.65

calafish_00208

ROA_03441

Recommended Standard Specifications for Valve Materials
Pressure-Containing Castings
(Continued)

(4) Carbon Moly Steel
ASTM A217 Grade WC1

Temp. range = −20°F to 850°F
Composition (Percent)
C 0.25 max
Mn 0.50 to 0.80
P 0.05 max
S 0.06 max
Si 0.60 max
Mo 0.45 to 0.66

(5) Chrome Moly Steel
ASTM A217 Grade WC6

Temp. range = −20°F to 1000°F
Composition (Percent)
C 0.20 max
Mn 0.50 to 0.80
P 0.05 max
S 0.06 max
Si 0.60 max
Cr 1.00 to 1.50
Mo 0.45 to 0.65

(6) Chrome Moly Steel
ASTM A217 Grade WC9

Temp. range = −20°F to 1050°F
Composition (Percent)
C 0.18 max
Mn 0.40 to 0.70
P 0.05 max
Si 0.60 max
Cr 2.00 to 2.75
Mo 0.90 to 1.20

(7) 3-1/2% Nickel Steel
ASTM A352 Grade LC3

Temp. range = −150°F to 650°F
Composition (Percent)
C 0.15 max
Mn 0.50 to 0.80
P 0.05 max
S 0.05 max
Si 0.60 max
Ni 3.00 to 4.00

(8) Chrome Moly Steel
ASTM A217 Grade C12

Temp. range = −20°F to 1100°F
Composition (Percent)
C 0.20 max
Si 1.00 max
Mn 0.35 to 0.65
Cr 8.00 to 10.00
Mo 0.90 to 1.20
P 0.05 max
S 0.06 max

(9) Type 304 Stainless Steel
ASTM A351 Grade CF-8

Temp. range = −425°F to 1500°F
Composition (Percent)
C 0.08 max
Mn 1.50 max
Si 2.00 max
S 0.04 max
P 0.04 max
Cr 18.00 to 21.00
Ni 8.00 to 11.00

(10) Type 316 Stainless Steel
ASTM A351 Grade CF-8M

Temp. range = −425°F to 1500°F
Composition (Percent)
C 0.08 max
Mn 1.50 max
Si 2.00 max
P 0.04 max
S 0.04 max
Cr 18.00 to 21.00
Ni 9.00 to 12.00
Mo 2.00 to 3.00

(11) Cast Iron
ASTM A126 Class B

Temp. range = −150°F to 450°F
Composition (Percent)
P 0.75 max
S 0.12 max

(12) Cast Iron
ASTM A126 Class C

Temp. range = −150°F to 450°F
Composition (Percent)
P 0.75 max
S 0.12 max

calafish_00209

Recommended Standard Specifications for Valve Materials
Pressure-Containing Castings
(Continued)

MAT'L CODE	MINIMUM PHYSICAL PROPERTIES				MODULUS OF ELASTICITY AT 70°F (PSI x 10^6)	APPROX. BRINELL HARDNESS
	Tensile (Psi)	Yield Point (Psi)	Elong. in 2" (%)	Reduction of Area (%)		
(1)	70,000	36,000	22	35	27.9	137-187
(2)	65,000	35,000	24	35	27.9	137-187
(3)	90,000	60,000	18	35	27.4	241 Max.
(4)	65,000	35,000	24	35	29.9	215 Max.
(5)	70,000	40,000	20	35	29.9	215 Max.
(6)	70,000	40,000	20	35	29.9	241 Max.
(7)	65,000	40,000	24	35	27.9	137
(8)	90,000	60,000	18	35	27.4	180-240
(9)	65,000	28,000	35	...	28.0	140
(10)	70,000	30,000	30	...	28.3	156-170
(11)	31,000	...	...	...	...	160-220
(12)	41,000	...	...	...	...	160-220
(13)	60,000	45,000	15	...	23-26	143-207
(14)	68,000	30,000	7	...	...	148-211
(15)	30,000	14,000	20	17	13.5	55-65*
(16)	40,000	18,000	20	20	15	75-85*
(17)	65,000	25,000	20	20	15.4	98*
(18)	75,000	30,000	12 min.	12	17	150
(19)	65,000	32,500	25	...	23	120-170
(20)	72,000	46,000	6	...	...	...
(21)	72,000	46,000	4	...	...	...
(22)	121,000	64,000	1-2	...	30.4	...

*500 kg load.

(13) Ductile Iron
ASTM A395 Type 60-45-15

Temp. range = −20°F to 650°F
Composition (Percent)
C 3.00 min
Si 2.75 max
P 0.08 max

(14) Ductile Ni-Resist* Iron
ASTM A439 Type D-2B

Temp. range = −20°F to 750°F
Composition (Percent)
C 3.00 max
Si 1.50 to 3.00
Mn 0.70 to 1.25
P 0.08 max
Ni 18.00 to 22.00
Cr 2.75 to 4.00

*Trademark of International Nickel Co.

(15) Standard Valve Bronze
ASTM B62

Temp. range = −325°F to 450°F
Composition (Percent)
Cu 84.00 to 86.00
Sn 4.00 to 6.00
Pb 4.00 to 6.00
Zn 4.00 to 6.00
Ni 1.00 max
Fe 0.30 max
P 0.05 max

calafish_00210

ROA_03443

Recommended Standard Specifications for Valve Materials
Pressure-Containing Castings
(Continued)

(16) Tin Bronze
ASTM B143 Alloy 1A

Temp. range = −325°F to 400°F
Composition (Percent)
Cu 86.00 to 89.00
Sn 9.00 to 11.00
Pb 0.30 max
Zn 1.00 to 3.00
Ni 1.00 max
Fe 0.15 max
P 0.05 max

(17) Manganese Bronze
ASTM B147 Alloy 8A

Temp. range = −325°F to 350°F
Composition (Percent)
Cu 55.00 to 60.00
Sn 1.00 max
Pb 0.40 max
Ni 0.50 max
Fe 0.40 to 2.00
Al 0.50 to 1.50
Mn 1.50 max
Zn Remainder

(18) Aluminum Bronze
ASTM B148 Alloy 9C

Temp. range = −325°F to 500°F
Composition (Percent)
Cu 83.00 min
Al 10.00 to 11.50
Fe 3.00 to 5.00
Mn 0.50
Ni 2.50 max
Min. total named elements = 99.5

(19) Monel* Alloy 411
(Weldable Grade)

Temp. range = −325°F to 900°F
Composition (Percent)
Ni 60.00 min
Cu 26.00 to 33.00
C 0.30 max
Mn 1.50 max
Fe 3.50 max
S 0.015 max
Si 1.00 to 2.00
Nb 1.00 to 3.00

(20) Nickel-Moly Alloy "B"
ASTM A494 (Hastelloy "B"†)

Temp. range = −325°F to 700°F
Composition (Percent)
Cr 1.00 max
Fe 4.00 to 6.00
C 0.12 max
Si 1.00 max
Co 2.50 max
Mn 1.00 max
V 0.20 to 0.60
Mo 26.00 to 30.00
P 0.04 max
S 0.03 max
Ni Remainder

(21) Nickel-Moly-Chrome Alloy "C"
ASTM A494 (Hastelloy "C"†)

Temp. range = −325°F to 1000°F
Composition (Percent)
Cr 15.50 to 17.50
Fe 4.50 to 7.50
W 3.75 to 5.25
C 0.12 max
Si 1.00 max
Co 2.50 max
Mn 1.00 max
V 0.20 to 0.40
Mo 16.00 to 18.00
P 0.04
S 0.03
Ni Remainder

(22) Cobalt-base Alloy No. 6
Stellite† No. 6

Composition (Percent)
C 0.90 to 1.40
Mn 1.00
W 3.00 to 6.00
Ni 3.00
Cr 26.00 to 32.00
Mo 1.00
Fe 3.00
Si 0.40 to 2.00
Co Remainder

*Trademark of International Nickel Co.
†Trademark of Stellite Div., Cabot Corp.

calafish_00211

Bar Stock Materials

Frequently Used for Trim Parts of Valves

(23) Aluminum Bar
ASTM B211 Alloy 2011-T3

Composition (Percent)
Si 0.40 max
Fe 0.70 max
Cu 5.00 to 6.00
Zn 0.30 max
Bi 0.20 to 0.60
Pb 0.20 to 0.60
Other Elements 0.15 max
Al Remainder

(24) Yellow Brass Bar
ASTM B16 1/2 Hard

Composition (Percent)
Cu 60.00 to 63.00
Pb 2.50 to 3.70
Fe 0.35 max
Zn Remainder

(25) Naval Brass Bar
ASTM B21 Alloy 464

Composition (Percent)
Cu 59.00 to 62.00
Sn 0.50 to 1.00
Pb 0.20 max
Zn Remainder

(26) Leaded Steel Bar
AISI 12L14

Composition (Percent)
C 0.15 max
Mn 0.80 to 1.20
P 0.04 to 0.09
S 0.25 to 0.35
Pb 0.15 to 0.35

(27) Carbon Steel Bar
ASTM A108 Grade 1018

Composition (Percent)
C 0.15 to 0.20
Mn 0.60 to 0.90
P 0.04 max
S 0.05 max

(28) AISI 4140 Chrome-Moly Steel
(Suitable for ASTM A193
Grade B7 bolt material)

Composition (Percent)
C 0.38 to 0.43
Mn 0.75 to 1.00
P 0.035 max
S 0.040 max
Si 0.20 to 0.35
Cr 0.80 to 1.10
Mo 0.15 to 0.25
Fe Remainder

(29) Type 302 Stainless Steel
ASTM A276 Type 302

Composition (Percent)
C 0.15 max
Mn 2.00 max
P 0.045 max
S 0.030 max
Si 1.00 max
Cr 17.00 to 19.00
Ni 8.00 to 10.00

(30) Type 304 Stainless Steel
ASTM A276 Type 304

Composition (Percent)
C 0.08 max
Mn 2.00 max
P 0.045 max
S 0.030 max
Si 1.00 max
Cr 18.00 to 20.00
Ni 8.00 to 12.00

(31) Type 316 Stainless Steel
ASTM A276 Type 316

Composition (Percent)
C 0.08 max
Mn 2.00 max
P 0.045 max
S 0.030 max
Si 1.00 max
Cr 16.00 to 18.00
Ni 10.00 to 14.00
Mo 2.00 to 3.00

Bar Stock Material (Continued)
Frequently Used for Trim Parts of Valves

(32) Type 316L Stainless Steel
ASTM A276 Type 316L

Composition (Percent)
C 0.03 max
Mn 2.00 max
P 0.045 max
S 0.030 max
Si 1.00 max
Cr 16.00 to 18.00
Ni 10.00 to 14.00
Mo 2.00 to 3.00

(33) Type 410 Stainless Steel
ASTM A276 Type 410

Composition (Percent)
C 0.15 max
Mn 1.00 max
P 0.040 max
S 0.030 max
Si 1.00 max
Cr 11.50 to 13.50
Al 0.10 to 0.30

(34) Type 17-4PH Stainless Steel
ASTM A461 Grade 630

Composition (Percent)
C 0.07 max
Mn 1.00 max
Si 1.00 max
P 0.04 max
S 0.03 max
Cr 15.50 to 17.50
Nb 0.05 to 0.45
Cu 3.00 to 5.00
Ni 3.00 to 5.00
Fe Remainder

(35) Nickel-Copper Alloy Bar
Alloy K500 (K Monel*)

Composition (Percent)
Ni 63.00 to 70.00
Fe 2.00 max
Mn 1.50 max
Si 1.00 max
C 0.25 max
S 0.01 max
Al 2.00 to 4.00
Ti 0.25 to 1.00
Cu Remainder

(36) Nickel-Moly Alloy "B" Bar
ASTM B335 (Hastelloy "B"†)

Composition (Percent)
Cr 1.00 max
Fe 4.00 to 6.00
C 0.05 max
Si 1.00 max
Co 2.50 max
Mn 1.00 max
V 0.20 to 0.40
Mo 26.00 to 30.00
P 0.025 max
S 0.030 max
Ni Remainder

(37) Nickel-Moly-Chrome Alloy "C" Bar
ASTM B336 (Hastelloy "C"†)

Composition (Percent)
Cr 14.50 to 16.50
Fe 4.00 to 7.00
W 3.00 to 4.50
C 0.08 max
Si 1.00 max
Co 2.50 max
Mn 1.00 max
Va 0.35 max
Mo 15.00 to 17.00
P 0.04
S 0.03
Ni Remainder

*Trademark of International Nickel Co.
†Trademark of Stellite Div., Cabot Corp.

MAT'L CODE	MINIMUM PHYSICAL PROPERTIES				MODULUS OF ELASTICITY AT 70°F (PSI x 10^6)	APPROX. BRINELL HARDNESS
	Tensile (Psi)	Yield Point (Psi)	Elong. in 2" (%)	Reduction of Area (%)		
23	44,000	36,000	15	...	10.2	95
24	45,000	15,000	7	50	14	...
25	60,000	27,000	22	55	...	...
26	79,000	71,000	16	52	...	163
27	69,000	48,000	38	62	...	143
28	135,000	115,000	22	63	29.9	255
29	85,000	35,000	60	70	28	150
30	85,000	35,000	60	70	...	149
31	80,000	30,000	60	70	28	149
32	81000	34,000	55	...	...	146
33	75,000	40,000	35	70	29	155
34	135,000	105,000	16	50	29	275-345
35	100,000	70,000	35	...	26	175-260
36	100,000	46,000	30	...	...	...
37	100,000	46,000	20	...	...	...

Physical Constants of Hydrocarbons

NO.	COMPOUND	FORMULA	MOLECULAR WEIGHT	BOILING POINT AT 14.696 psia (°F)	VAPOR PRESSURE AT 100° F (psia)	FREEZING POINT AT 14.696 psia (°F)	CRITICAL CONSTANTS		SPECIFIC GRAVITY at 14.696 psia	
							Critical Temperature (°F)	Critical Pressure (psia)	Liquid,[3,4] 60° F/60° F	Gas at 60° F (Air = 1)[7]
1	Methane	CH_4	16.043	−258.69	(5000)[2]	−296.46[6]	−116.63	667.8	0.3[8]	0.5539
2	Ethane	C_2H_6	30.070	−127.48	(800)[2]	−297.89[5]	90.09	707.8	0.3564[7]	1.0382
3	Propane	C_3H_8	44.097	−43.67	190.	−305.84[6]	206.01	616.3	0.5077[7]	1.5225
4	n-Butane	C_4H_{10}	58.124	31.10	51.6	−217.05	305.65	550.7	0.5844[7]	2.0068
5	Isobutane	C_4H_{10}	58.124	10.90	72.2	−255.29	274.98	529.1	0.5631[7]	2.0068
6	n-Pentane	C_5H_{12}	72.151	96.92	15.570	−201.51	385.7	488.6	0.6310	2.4911
7	Isopentane	C_5H_{12}	72.151	82.12	20.44	−255.83	369.10	490.4	0.6247	2.4911
8	Neopentane	C_5H_{12}	72.151	49.10	35.9	2.17	321.13	464.0	0.5967[7]	2.4911
9	n-Hexane	C_6H_{14}	86.178	155.72	4.956	−139.58	453.7	436.9	0.6640	2.9753
10	2-Methylpentane	C_6H_{14}	86.178	140.47	6.767	−244.63	435.83	436.6	0.6579	2.9753
11	3-Methylpentane	C_6H_{14}	86.178	145.89	6.098	...	448.3	453.1	0.6689	2.9753
12	Neohexane	C_6H_{14}	86.178	121.52	9.856	−147.72	420.13	446.8	0.6540	2.9753
13	2,3-Dimethylbutane	C_6H_{14}	86.178	136.36	7.404	−199.38	440.29	453.5	0.6664	2.9753
14	n-Heptane	C_7H_{16}	100.205	209.17	1.620	−131.05	512.8	396.8	0.6882	3.4596
15	2-Methylhexane	C_7H_{16}	100.205	194.09	2.271	−180.89	495.00	396.5	0.6830	3.4596
16	3-Methylhexane	C_7H_{16}	100.205	197.32	2.130	...	503.78	408.1	0.6917	3.4596
17	3-Ethylpentane	C_7H_{16}	100.205	200.25	2.012	−181.48	513.48	419.3	0.7028	3.4596
18	2,2-Dimethylpentane	C_7H_{16}	100.205	174.54	3.492	−190.86	477.23	402.2	0.6782	3.4596
19	2,4-Dimethylpentane	C_7H_{16}	100.205	176.89	3.292	−182.63	475.95	396.9	0.6773	3.4596
20	3,3-Dimethylpentane	C_7H_{16}	100.205	186.91	2.773	−210.01	505.86	427.2	0.6976	3.4596
21	Triptane	C_7H_{16}	100.205	177.58	3.374	−12.82	496.44	428.4	0.6946	3.4596

- Continued -

calafish_00215

ROA_03448

22	n-Octane	C_8H_{18}	114.232	258.22	0.537	−70.18	564.22	360.6	0.7068	3.9439
23	Diisobutyl	C_8H_{18}	114.232	228.39	1.101	−132.07	530.44	360.6	0.6979	3.9439
24	Isooctane	C_8H_{18}	114.232	210.63	1.708	−161.27	519.46	372.4	0.6962	3.9439
25	n-Nonane	C_9H_{20}	128.259	303.47	0.179	−64.28	610.68	332.	0.7217	4.4282
26	n-Decane	$C_{10}H_{22}$	142.286	345.48	0.0597	−21.36	652.1	304.	0.7342	4.9125
27	Cyclopentane	C_5H_{10}	70.135	120.65	9.914	−136.91	461.5	653.8	0.7504	2.4215
28	Methylcyclopentane	C_6H_{12}	84.162	161.25	4.503	−224.44	499.35	548.9	0.7536	2.9057
29	Cyclohexane	C_6H_{12}	84.162	177.29	3.264	43.77	536.7	591.	0.7834	2.9057
30	Methylcyclohexane	C_7H_{14}	98.189	213.68	1.609	−195.87	570.27	503.5	0.7740	3.3900
31	Ethylene	C_2H_4	28.054	−154.62	...	−272.45[5]	48.58	729.8	...	0.9686
32	Propene	C_3H_6	42.081	−53.90	226.4	−301.45[5]	196.9	669.	0.5220[7]	1.4529
33	1-Butene	C_4H_8	56.108	20.75	63.05	−301.63[5]	295.6	583.	0.6013[7]	1.9372
34	Cis-2-Butene	C_4H_8	56.108	38.69	45.54	−218.06	324.37	610.	0.6271[7]	1.9372
35	Trans-2-Butene	C_4H_8	56.108	33.58	49.80	−157.96	311.86	595.	0.6100[7]	1.9372
36	Isobutene	C_4H_8	56.108	19.59	63.40	−220.61	292.55	580.	0.6004[7]	1.9372
37	1-Pentene	C_5H_{10}	70.135	85.93	19.115	−265.39	376.93	590.	0.6457	2.4215
38	1,2-Butadiene	C_4H_6	54.092	51.53	(20.)[2]	−213.16	(339.)[2]	(653.)[2]	0.658[7]	1.8676
39	1,3-Butadiene	C_4H_6	54.092	24.06	(60.)[2]	−164.02	306.	628.	0.6272[7]	1.8676
40	Isoprene	C_5H_8	68.119	93.30	16.672	−230.74	(412.)[2]	(558.4)[2]	0.6861	2.3519
41	Acetylene	C_2H_2	26.038	−119.[5]	...	−114.[5]	95.31	890.4	0.615[9]	0.8990
42	Benzene	C_6H_6	78.114	176.17	3.224	41.96	552.22.	710.4	0.8844	2.6969
43	Toluene	C_7H_8	92.141	231.13	1.032	−138.94	605.55	595.9	0.8718	3.1812
44	Ethylbenzene	C_8H_{10}	106.168	277.16	0.371	−138.91	651.24	523.5	0.8718	3.6655
45	o-Xylene	C_8H_{10}	106.168	291.97	0.264	−13.30	675.0	541.4	0.8848	3.6655
46	m-Xylene	C_8H_{10}	106.168	282.41	0.326	−54.12	651.02	513.6	0.8687	3.6655
47	p-Xylene	C_8H_{10}	106.168	281.05	0.342	55.86	649.6	509.2	0.8657	3.6855
48	Styrene	C_8H_8	104.152	293.29	(0.24)[2]	−23.10	706.0	580.	0.9110	3.5959
49	Isopropylbenzene	C_9H_{12}	120.195	306.34	0.188	−140.82	676.4	465.4	0.8663	4.1498

1. Calculated values.
2. ( )-Estimated values.
3. Air saturated hydrocarbons.
4. Absolute values from weights in vacuum.
5. At saturation pressure (triple point).
6. Sublimation point.
7. Saturation pressure and 60°F.
8. Apparent value for methane at 60°F.
9. Specific gravity, 119°F/60°F (sublimation point).

calafish_00216

ROA_03449

Physical Constants of Various Fluids

FLUID	FORMULA	MOLECULAR WEIGHT	BOILING POINT (°F AT 14.696 PSIA)	VAPOR PRESSURE @ 70°F (PSIG)	CRITICAL TEMP. (°F)	CRITICAL PRESSURE (PSIA)	SPECIFIC GRAVITY	
							Liquid 60/60°F	Gas
Acetic Acid	$HC_2H_3O_2$	60.05	245				1.05	
Acetone	C_3H_6O	58.08	133		455	691	0.79	2.01
Air	N_2O_2	28.97	−317		−221	547	0.86‡	1.0
Alcohol, Ethyl	C_2H_6O	46.07	173	2.3†	470	925	0.794	1.59
Alcohol, Methyl	CH_4O	32.04	148	4.63†	463	1174	0.796	1.11
Ammonia	NH_3	17.03	−28	114	270	1636	0.62	0.59
Ammonium Chloride*	NH_4Cl						1.07	
Ammonium Hydroxide*	NH_4OH						0.91	
Ammonium Sulfate*	$(NH_4)_2SO_4$						1.15	
Aniline	C_6H_7N	93.12	365		798	770	1.02	
Argon	A	39.94	−302		−188	705	1.65	1.38
Beer							1.01	
Bromine	Br_2	159.84	138		575		2.93	5.52
Calcium Chloride*	$CaCl_2$						1.23	
Carbon Dioxide	CO_2	44.01	−109	839	88	1072	0.801‡	1.52
Carbon Disulfide	CS_2	76.1	115				1.29	2.63
Carbon Monoxide	CO	28.01	−314		−220	507	0.80	0.97
Carbon Tetrachloride	CCl_4	153.84	170		542	661	1.59	5.31
Chlorine	Cl_2	70.91	−30	85	291	1119	1.42	2.45
Chromic Acid	H_2CrO_4	118.03					1.21	
Citric Acid	$C_6H_8O_7$	192.12					1.54	
Copper Sulfate*	$CuSO_4$						1.17	

- Continued -

calafish_00217

Ether	$(C_2H_5)_2O$	74.12	34				0.74	2.55
Ferric Chloride*	$FeCl_3$						1.23	
Fluorine	F_2	38.00	−305	300	−200	809	1.11	1.31
Formaldehyde	H_2CO	30.03	−6				0.82	1.08
Formic Acid	HCO_2H	46.03	214				1.23	
Furfural	$C_5H_4O_2$	96.08	324				1.16	
Glycerine	$C_3H_8O_3$	92.09	554				1.26	
Glycol	$C_2H_6O_2$	62.07	387				1.11	
Helium	He	4.003	−454		−450	33	0.18	0.14
Hydrochloric Acid	HCl	36.47	−115				1.64	
Hydrofluoric Acid	HF	20.01	66	0.9	446		0.92	
Hydrogen	H_2	2.016	−422		−400	188	0.07‡	0.07
Hyrogen Chloride	HCl	36.47	−115	613	125	1198	0.86	1.26
Hydrogen Sulfide	H_2S	34.07	−76	252	213	1307	0.79	1.17
Isopropyl Alcohol	C_3H_8O	60.09	180				0.78	2.08
Linseed Oil			538				0.93	
Magnesium Chloride*	$MgCl_2$						1.22	
Mercury	Hg	200.61	670				13.6	6.93
Methyl Bromide	CH_3Br	94.95	38	13	376		1.73	3.27
Methyl Chloride	CH_3Cl	50.49	−11	59	290	969	0.99	1.74
Naphthalene	$C_{10}H_8$	128.16	424				1.14	4.43
Nitric Acid	HNO_3	63.02	187				1.5	
Nitrogen	N_2	28.02	−320		−233	493	0.81‡	0.97
Oil, Vegetable							0.91 - 0.94	
Oxygen	O_2	32	−297		−181	737	1.14‡	1.105

*Aqueous Solution - 25% by weight of compound.
†Vapor pressure in psia at 100°F.
‡Density of liquid, gm/ml at normal boiling point.

- Continued -

calafish_00218

ROA_03451

Physical Constants of Various Fluids (Continued)

FLUID	FORMULA	MOLECULAR WEIGHT	BOILING POINT (°F AT 14.696 PSIA)	VAPOR PRESSURE @ 70°F (PSIG)	CRITICAL TEMP. (°F)	CRITICAL PRESSURE (PSIA)	SPECIFIC GRAVITY	
							Liquid 60/60°F	Gas
Phosgene	$COCl_2$	98.92	47	10.7	360	823	1.39	3.42
Phosphoric Acid	H_3PO_4	98.00	415				1.83	
Potassium Carbonate*	K_2CO_3						1.24	
Potassium Chloride*	KCl						1.16	
Potassium Hydroxide*	KOH						1.24	
Refrigerant 11	CCl_3F	137.38	75	13.4	388	635		5.04
Refrigerant 12	CCl_2F_2	120.93	−22	70.2	234	597		4.2
Refrigerant 13	$CClF_3$	104.47	−115	458.7	84	561		
Refrigerant 21	$CHCl_2F$	102.93	48	8.4	353	750		3.82
Refrigerant 22	$CHClF_2$	86.48	−41	122.5	205	716		
Refrigerant 23	CHF_3	70.02	−119	635	91	691		
Sodium Chloride*	NaCl						1.19	
Sodium Hydroxide*	NaOH						1.27	
Sodium Sulfate*	Na_2SO_4						1.24	
Sodium Thiosulfate*	$Na_2S_2O_3$						1.23	
Starch	$(C_6H_{10}O_5)x$						1.50	
Sugar Solutions*	$C_{12}H_{22}O_{11}$						1.10	
Sulfuric Acid	H_2SO_4	98.08	626				1.83	
Sulfur Dioxide	SO_2	64.6	14	34.4	316	1145	1.39	2.21
Turpentine			320				0.87	
Water	H_2O	18.016	212	0.8492†	706	3208	1.00	0.62
Zinc Chloride*	$ZnCl_2$						1.24	
Zinc Sulfate*	$ZnSO_4$						1.31	

*Aqueous Solution - 25% by weight of compound.
†Vapor pressure in psia at 100°F.

calafish_00219

Properties of Water

Temperature of Water (°F)	Saturation Pressure (Pounds Per Square Inch Absolute)	Weight (Pounds Per Gallon)	Specific Gravity 60/60 F	Conversion Factor,* lbs./hr. to GPM
32	.0886	8.345	1.0013	.00199
40	.1217	8.345	1.0013	.00199
50	.1781	8.340	1.0007	.00199
60	.2653	8.334	1.0000	.00199
70	.3631	8.325	.9989	.00200
80	.5069	8.314	.9976	.00200
90	.6982	8.303	.9963	.00200
100	.9492	8.289	.9946	.00201
110	1.2748	8.267	.9919	.00201
120	1.6924	8.253	.9901	.00201
130	2.2225	8.227	.9872	.00202
140	2.8886	8.207	.9848	.00203
150	3.718	8.182	.9818	.00203
160	4.741	8.156	.9786	.00204
170	5.992	8.127	.9752	.00205
180	7.510	8.098	.9717	.00205
190	9.339	8.068	.9681	.00206
200	11.526	8.039	.9646	.00207
210	14.123	8.005	.9605	.00208
212	14.696	7.996	.9594	.00208
220	17.186	7.972	.9566	.00209
240	24.969	7.901	.9480	.00210
260	35.429	7.822	.9386	.00211
280	49.203	7.746	.9294	.00215
300	67.013	7.662	.9194	.00217
350	134.63	7.432	.8918	.00224
400	247.31	7.172	.8606	.00232
450	422.6	6.892	.8270	.00241
500	680.8	6.553	.7863	.00254
550	1045.2	6.132	.7358	.00271
600	1542.9	5.664	.6796	.00294
700	3093.7	3.623	.4347	.00460

*Multiply flow in pounds per hour by the factor to get equivalent flow in gallons per minute. Weight per gallon is based on 7.48 gallons per cubic foot.

Properties of Saturated Steam

ABSOLUTE PRESSURE		VACUUM (INCHES OF Hg)	TEMPER-ATURE t (°F)	HEAT OF THE LIQUID (BTU/LB)	LATENT HEAT OF EVAPORATION (BTU/LB)	TOTAL HEAT OF STEAM H_g (BTU/LB)	SPECIFIC VOLUME $\overline{V}$ (CU FT PER LB)
Lbs Per Sq In. P	Inches of Hg						
0.20	0.41	29.51	53.14	21.21	1063.8	1085.0	1526.0
0.25	0.51	29.41	59.30	27.36	1060.3	1087.7	1235.3
0.30	0.61	29.31	64.47	32.52	1057.4	1090.0	1039.5
0.35	0.71	29.21	68.93	36.97	1054.9	1091.9	898.5
0.40	0.81	29.11	72.86	40.89	1052.7	1093.6	791.9
0.45	0.92	29.00	76.38	44.41	1050.7	1095.1	708.5
0.50	1.02	28.90	79.58	47.60	1048.8	1096.4	641.4
0.60	1.22	28.70	85.21	53.21	1045.7	1098.9	540.0
0.70	1.43	28.49	90.08	58.07	1042.9	1101.0	466.9
0.80	1.63	28.29	94.38	62.36	1040.4	1102.8	411.7
0.90	1.83	28.09	98.24	66.21	1038.3	1104.5	368.4
1.0	2.04	27.88	101.74	69.70	1036.3	1106.0	333.6
1.2	2.44	27.48	107.92	75.87	1032.7	1108.6	280.9
1.4	2.85	27.07	113.26	81.20	1029.6	1110.8	243.0
1.6	3.26	26.66	117.99	85.91	1026.9	1112.8	214.3
1.8	3.66	26.26	122.23	90.14	1024.5	1114.6	191.8
2.0	4.07	25.85	126.08	93.99	1022.2	1116.2	173.73
2.2	4.48	25.44	129.62	97.52	1020.2	1117.7	158.85
2.4	4.89	25.03	132.89	100,79	1018.3	1119.1	146.38
2.6	5.29	24.63	135.94	103.83	1016.5	1120.3	135.78
2.8	5.70	24.22	138.79	106.68	1014.8	1121.5	126.65
3.0	6.11	23.81	141.48	109.37	1013.2	1122.6	118.71
3.5	7.13	22.79	147.57	115.46	1009.6	1125.1	102.72
4.0	8.14	21.78	152.97	120.86	1006.4	1127.3	90.63
4.5	9.16	20.76	157.83	125.71	1003.6	1129.3	81.16
5.0	10.18	19.74	162.24	130.13	1001.0	1131.1	73.52
5.5	11.20	18.72	166.30	134.19	998.5	1132.7	67.24
6.0	12.22	17.70	170.06	137.96	996.2	1134.2	61.98
6.5	13.23	16.69	173.56	141.47	994.1	1135.6	57.50
7.0	14.25	15.67	176.85	144.76	992.1	1136.9	53.64
7.5	15.27	14.65	179.94	147.86	990.2	1138.1	50.29
8.0	16.29	13.63	182.86	150.79	988.5	1139.3	47.34
8.5	17.31	12.61	185.64	153.57	986.8	1140.4	44.73
9.0	18.32	11.60	188.28	156.22	985.2	1141.4	42.40
9.5	19.34	10.58	190.80	158.75	983.6	1142.3	40.31
10.0	20.36	9.56	193.21	161.17	982.1	1143.3	38.42
11.0	22.40	7.52	197.75	165.73	979.3	1145.0	35.14
12.0	24.43	5.49	201.96	169.96	976.6	1146.6	32.40
13.0	26.47	3.45	205.88	173.91	974.2	1148.1	30.06
14.0	28.50	1.42	209.56	177.61	971.9	1149.5	28.04

calafish_00221

ROA_03454

Properties of Saturated Steam

PRESSURE (LBS PER SQ IN.)		TEMPER-ATURE	HEAT OF THE LIQUID	LATENT HEAT OF EVAPORATION	TOTAL HEAT OF STEAM	SPECIFIC VOLUME
Absolute P'	Gauge P	t (°F)	(BTU/LB)	(BTU/LB)	H_p (BTU/LB)	$\overline{V}$ (CU FT PER LB)
14.696	0.0	212.00	180.07	970.3	1150.4	26.80
15.0	0.3	213.03	181.11	969.7	1150.8	26.29
16.0	1.3	216.32	184.42	967.6	1152.0	24.75
17.0	2.3	219.44	187.56	965.5	1153.1	23.39
18.0	3.3	222.41	190.56	963.6	1154.2	22.17
19.0	4.3	225.24	193.42	961.9	1155.3	21.08
20.0	5.3	227.96	196.16	960.1	1156.3	20.089
21.0	6.3	230.57	198.79	958.4	1157.2	19.192
22.0	7.3	233.07	201.33	956.8	1158.1	18.375
23.0	8.3	235.49	203.78	955.2	1159.0	17.627
24.0	9.3	237.82	206.14	953.7	1159.8	16.938
25.0	10.3	240.07	208.42	952.1	1160.6	16.303
26.0	11.3	242.25	210.62	950.7	1161.3	15.715
27.0	12.3	244.36	212.75	949.3	1162.0	15.170
28.0	13.3	246.41	214.83	947.9	1162.7	14.663
29.0	14.3	248.40	216.86	946.5	1163.4	14.189
30.0	15.3	250.33	218.82	945.3	1164.1	13.746
31.0	16.3	252.22	220.73	944.0	1164.7	13.330
32.0	17.3	254.05	222.59	942.8	1165.4	12.940
33.0	18.3	255.84	224.41	941.6	1166.0	12.572
34.0	19.3	257.58	226.18	940.3	1166.6	12.226
35.0	20.3	259.28	227.91	939.2	1167.1	11.898
36.0	21.3	260.95	229.60	938.0	1167.6	11.588
37.0	22.3	262.57	231.26	936.9	1168.2	11.294
38.0	23.3	264.16	232.89	935.8	1168.7	11.015
39.0	24.3	265.72	234.48	934.7	1169.2	10.750
40.0	25.3	267.25	236.03	933.7	1169.7	10.498
41.0	26.3	268.74	237.55	932.6	1170.2	10.258
42.0	27.3	270.21	239.04	931.6	1170.7	10.029
43.0	28.3	271.64	240.51	930.6	1171.1	9.810
44.0	29.3	273.05	241.95	929.6	1171.6	9.601
45.0	30.3	274.44	243.36	928.6	1172.0	9.401
46.0	31.3	275.80	244.75	927.7	1172.4	9.209
47.0	32.3	277.13	246.12	926.7	1172.9	9.025
48.0	33.3	278.45	247.47	925.8	1173.3	8.848
49.0	34.3	279.74	248.79	924.9	1173.7	8.678
50.0	35.3	281.01	250.09	924.0	1174.1	8.515
51.0	36.3	282.26	251.37	923.0	1174.4	8.359
52.0	37.3	283.49	252.63	922.2	1174.8	8.208
53.0	38.3	284.70	253.87	921.3	1175.2	8.062
54.0	39.3	285.90	255.09	920.5	1175.6	7.922

- Continued -

calafish_00222

ROA_03455

Properties of Saturated Steam (Continued)

PRESSURE (LBS PER SQ IN.)		TEMPERATURE	HEAT OF THE LIQUID	LATENT HEAT OF EVAPORATION	TOTAL HEAT OF STEAM	SPECIFIC VOLUME
Absolute P'	Gauge P	t (°F)	(BTU/LB)	(BTU/LB)	H_g (BTU/LB)	$\overline{V}$ (CU FT PER LB)
55.0	40.3	287.07	256.30	919.6	1175.9	7.787
56.0	41.3	288.22	257.50	918.8	1176.3	7.656
57.0	42.3	289.37	258.67	917.9	1176.6	7.529
58.0	43.3	290.50	259.82	917.1	1176.9	7.407
59.0	44.3	291.61	260.96	916.3	1177.3	7.289
60.0	45.3	292.71	262.09	915.5	1177.6	7.175
61.0	46.3	293.79	263.20	914.7	1177.9	7.064
62.0	47.3	294.85	264.30	913.9	1178.2	6.957
63.0	48.3	295.90	265.38	913.1	1178.5	6.853
64.0	49.3	296.94	266.45	912.3	1178.8	6.752
65.0	50.3	297.97	267.50	911.6	1179.1	6.655
66.0	51.3	298.99	268.55	910.8	1179.4	6.560
67.0	52.3	299.99	269.58	910.1	1179.7	6.468
68.0	53.3	300.98	270.60	909.4	1180.0	6.378
69.0	54.3	301.96	291.61	908.7	1180.3	6.291
70.0	55.3	302.92	272.61	907.9	1180.6	6.206
71.0	56.3	303.88	273.60	907.2	1180.8	6.124
72.0	57.3	304.83	274.57	906.5	1181.1	6.044
73.0	58.3	305.76	275.54	905.8	1181.3	5.966
74.0	59.3	306.68	276.49	905.1	1181.6	5.890
75.0	60.3	307.60	277.43	904.5	1181.9	5.816
76.0	61.3	308.50	278.37	903.7	1182.1	5.743
77.0	62.3	309.40	279.30	903.1	1182.4	5.673
78.0	63.3	310.29	280.21	902.4	1182.6	5.604
79.0	64.3	311.16	281.12	901.7	1182.8	5.537
80.0	65.3	312.03	282.02	901.1	1183.1	5.472
81.0	66.3	312.89	282.91	900.4	1183.3	5.408
82.0	67.3	313.74	283.79	899.7	1183.5	5.346
83.0	68.3	314.59	284.66	899.1	1183.8	5.285
84.0	69.3	315.42	285.53	898.5	1184.0	5.226
85.0	70.3	316.25	286.39	897.8	1184.2	5.168
86.0	71.3	317.07	287.24	897.2	1184.4	5.111
87.0	72.3	317.88	288.08	896.5	1184.6	5.055
88.0	73.3	318.68	288.91	895.9	1184.8	5.001
89.0	74.3	319.48	289.74	895.3	1185.1	4.948
90.0	75.3	320.27	290.56	894.7	1185.3	4.896
91.0	76.3	321.06	291.38	894.1	1185.5	4.845
92.0	77.3	321.83	292.18	893.5	1185.7	4.796
93.0	78.3	322.60	292.98	892.9	1185.9	4.747
94.0	79.3	323.36	293.78	892.3	1186.1	4.699
95.0	80.3	324.12	294.56	891.7	1186.2	4.652
96.0	81.3	324.87	295.34	891.1	1186.4	4.606
97.0	82.3	325.61	296.12	890.5	1186.6	4.561
98.0	83.3	326.35	296.89	889.9	1186.8	4.517
99.0	84.3	327.08	297.65	889.4	1187.0	4.474

- Continued -

calafish_00223

ROA_03456

Properties of Saturated Steam (Continued)

PRESSURE (LBS PER SQ IN.)		TEMPERATURE	HEAT OF THE	LATENT HEAT OF	TOTAL HEAT OF STEAM	SPECIFIC VOLUME
Absolute P'	Gauge P	t (°F)	LIQUID (BTU/LB)	EVAPORATION (BTU/LB)	H_g (BTU/LB)	V (CU FT PER LB)
100.0	85.3	327.81	298.40	888.8	1187.2	4.432
101.0	86.3	328.53	299.15	888.2	1187.4	4.391
102.0	87.3	329.25	299.90	887.6	1187.5	4.350
103.0	88.3	329.96	300.64	887.1	1187.7	4.310
104.0	89.3	330.66	301.37	886.5	1187.9	4.271
105.0	90.3	331.36	302.10	886.0	1188.1	4.232
106.0	91.3	332.05	302.82	885.4	1188.2	4.194
107.0	92.3	332.74	303.54	884.9	1188.4	4.157
108.0	93.3	333.42	304.26	884.3	1188.6	4.120
109.0	94.3	334.10	304.97	883.7	1188.7	4.084
110.0	95.3	334.77	305.66	883.2	1188.9	4.049
111.0	96.3	335.44	306.37	882.6	1189.0	4.015
112.0	97.3	336.11	307.06	882.1	1189.2	3.981
113.0	98.3	336.77	307.75	881.6	1189.4	3.947
114.0	99.3	337.42	308.43	881.1	1189.5	3.914
115.0	100.3	338.07	309.11	880.6	1189.7	3.882
116.0	101.3	338.72	309.79	880.0	1189.8	3.850
117.0	102.3	339.36	310.46	879.5	1190.0	3.819
118.0	103.3	339.99	311.12	879.0	1190.1	3.788
119.0	104.3	340.62	311.78	878.4	1190.2	3.758
120.0	105.3	341.25	312.44	877.9	1190.4	3.728
121.0	106.3	341.88	313.10	877.4	1190.5	3.699
122.0	107.3	342.50	313.75	876.9	1190.7	3.670
123.0	108.3	343.11	314.40	876.4	1190.8	3.642
124.0	109.3	343.72	315.04	875.9	1190.9	3.614
125.0	110.3	344.33	315.68	875.4	1191.1	3.587
126.0	111.3	344.94	316.31	874.9	1191.2	3.560
127.0	112.3	345.54	316.94	874.4	1191.3	3.533
128.0	113.3	346.13	317.57	873.9	1191.5	3.507
129.0	114.3	346.73	318.19	873.4	1191.6	3.481
130.0	115.3	347.32	318.81	872.9	1191.7	3.455
131.0	116.3	347.90	319.43	872.5	1191.9	3.430
132.0	117.3	348.48	320.04	872.0	1192.0	3.405
133.0	118.3	349.06	320.65	871.5	1192.1	3.381
134.0	119.3	349.64	321.25	871.0	1192.2	3.357
135.0	120.3	350.21	321.85	870.6	1192.4	3.333
136.0	121.3	350.78	322.45	870.1	1192.5	3.310
137.0	122.3	351.35	323.05	869.6	1192.6	3.287
138.0	123.3	351.91	323.64	869.1	1192.7	3.264
139.0	124.3	352.47	324.23	868.7	1192.9	3.242
140.0	125.3	353.02	324.82	868.2	1193.0	3.220
141.0	126.3	353.57	325.40	867.7	1193.1	3.198
142.0	127.3	354.12	325.98	867.2	1193.2	3.177
143.0	128.3	354.67	326.56	866.7	1193.3	3.155
144.0	129.3	355.21	327.13	866.3	1193.4	3.134

- Continued -

calafish_00224

ROA_03457

Properties of Saturated Steam (Continued)

PRESSURE (LBS PER SQ IN.)		TEMPER-ATURE	HEAT OF THE LIQUID	LATENT HEAT OF EVAPORATION	TOTAL HEAT OF STEAM	SPECIFIC VOLUME
Absolute P'	Gauge P	t (°F)	(BTU/LB)	(BTU/LB)	H_g (BTU/LB)	V (CU FT PER LB)
145.0	130.3	355.76	327.70	866.8	1193.5	3.114
146.0	131.3	356.29	328.27	865.3	1193.6	3.094
147.0	132.3	356.83	328.83	864.9	1193.8	3.074
148.0	133.3	357.36	329.39	864.5	1193.9	3.054
149.0	134.3	357.89	329.95	864.0	1194.0	3.034
150.0	135.3	358.42	330.51	863.6	1194.1	3.015
152.0	137.3	359.46	331.61	862.7	1194.3	2.977
154.0	139.3	360.49	332.70	861.8	1194.5	2.940
156.0	141.3	361.52	333.79	860.9	1194.7	2.904
158.0	143.3	362.53	334.86	860.0	1194.9	2.869
160.0	145.3	363.53	335.93	859.2	1195.1	2.834
162.0	147.3	364.53	336.98	858.3	1195.3	2.801
164.0	149.3	365.51	338.02	857.5	1195.5	2.768
166.0	151.3	366.48	339.05	856.6	1195.7	2.736
168.0	153.3	367.45	340.07	855.7	1195.8	2.705
170.0	155.3	368.41	341.09	854.9	1196.0	2.675
172.0	157.3	369.36	342.10	854.1	1196.2	2.646
174.0	159.3	370.29	343.10	853.3	1196.4	2.616
176.0	161.3	371.22	344.09	852.4	1196.5	2.587
178.0	163.3	372.14	345.08	851.6	1196.7	2.559
180.0	165.3	373.06	346.03	850.8	1196.9	2.532
182.0	167.3	373.96	347.00	850.0	1197.0	2.505
184.0	169.3	374.86	347.98	849.2	1197.2	2.479
186.0	171.3	375.75	348.92	848.4	1197.3	2.454
188.0	173.3	376.64	349.86	847.6	1197.5	2.429
190.0	175.3	377.51	350.79	846.8	1197.6	2.404
192.0	177.3	378.38	351.72	846.1	1197.8	2.380
194.0	179.3	379.24	352.64	845.3	1197.9	2.356
196.0	181.3	380.10	353.55	844.5	1198.1	2.333
198.0	183.3	380.95	354.46	843.7	1198.2	2.310
200.0	185.3	381.79	355.36	843.0	1198.4	2.288
205.0	190.3	383.86	357.58	841.1	1198.7	2.234
210.0	195.3	385.90	359.77	839.2	1199.0	2.183
215.0	200.3	387.89	361.91	837.4	1199.3	2.134
220.0	205.3	389.86	364.02	835.6	1199.6	2.087
225.0	210.3	391.79	366.09	833.8	1199.9	2.0422
230.0	215.3	393.68	368.13	832.0	1200.1	1.9992
235.0	220.3	395.54	370.14	830.3	1200.4	1.9579
240.0	225.3	397.37	372.12	828.5	1200.6	1.9183
245.0	230.3	399.18	374.08	826.8	1200.9	1.8803
250.0	235.3	400.95	376.00	825.1	1201.1	1.8438
255.0	240.3	402.70	377.89	823.4	1201.3	1.8086
260.0	245.3	404.42	379.76	821.8	1201.5	1.7748
265.0	250.3	406.11	381.60	820.1	1201.7	1.7422
270.0	255.3	407.78	383.42	818.5	1201.9	1.7107

- Continued -

Properties of Saturated Steam (Continued)

PRESSURE (LBS PER SQ IN.)		TEMPERATURE	HEAT OF THE LIQUID	LATENT HEAT OF EVAPORATION	TOTAL HEAT OF STEAM	SPECIFIC VOLUME
Absolute P'	Gauge P	t (°F)	(BTU/LB)	(BTU/LB)	H_g (BTU/LB)	V (CU FT PER LB)
275.0	260.3	409.43	385.21	816.9	1202.1	1.6804
280.0	265.3	411.06	386.98	815.3	1202.3	1.6511
285.0	270.3	412.65	388.73	813.7	1202.4	1.6228
290.0	275.3	414.23	390.46	812.1	1202.6	1.5954
295.0	280.3	415.79	392.16	810.5	1202.7	1.5689
300.0	285.3	417.33	393.84	809.0	1202.8	1.5433
320.0	305.3	423.29	400.39	803.0	1203.4	1.4486
340.0	325.3	428.97	406.66	797.1	1203.7	1.3645
360.0	345.3	434.40	412.67	791.4	1204.1	1.2895
380.0	365.3	439.60	418.46	785.8	1204.3	1.2222
400.0	385.3	444.59	424.0	780.5	1204.5	1.1613
420.0	405.3	449.39	429.4	775.2	1204.6	1.1061
440.0	425.3	454.02	434.6	770.0	1204.6	1.0556
460.0	445.3	458.50	439.7	764.9	1204.6	1.0094
480.0	465.3	462.82	444.6	759.9	1204.5	0.9670
500.0	485.3	467.01	449.4	755.0	1204.4	0.9278
520.0	505.3	471.07	454.1	750.1	1204.2	0.8915
540.0	525.3	475.01	458.6	745.4	1204.0	0.8578
560.0	545.3	478.85	463.0	740.8	1203.8	0.8265
580.0	565.3	482.58	467.4	736.1	1203.5	0.7973
600.0	585.3	486.21	471.6	731.6	1203.2	0.7698
620.0	605.3	489.75	475.7	727.2	1202.9	0.7440
640.0	625.3	493.21	479.8	722.7	1202.5	0.7198
660.0	645.3	496.58	483.8	718.3	1202.1	0.6971
680.0	665.3	499.88	487.7	714.0	1201.7	0.6757
700.0	685.3	503.10	491.5	709.7	1201.2	0.6554
720.0	705.3	506.25	495.3	705.4	1200.7	0.6362
740.0	725.3	509.34	499.0	701.2	1200.2	0.6180
760.0	745.3	512.36	502.6	697.1	1199.7	0.6007
780.0	765.3	515.33	506.2	692.9	1199.1	0.5843
800.0	785.3	518.23	509.7	688.9	1198.6	0.5687
820.0	805.3	521.08	513.2	684.8	1198.0	0.5538
840.0	825.3	523.88	516.6	680.8	1197.4	0.5396
860.0	845.3	526.63	520.0	676.8	1196.8	0.5260
880.0	865.3	529.33	523.3	672.8	1196.1	0.5130
900.0	885.3	531.98	526.6	668.8	1195.4	0.5006
920.0	905.3	534.59	529.8	664.9	1194.7	0.4886
940.0	925.3	537.16	533.0	661.0	1194.0	0.4772
960.0	945.3	539.68	536.2	657.1	1193.3	0.4663
980.0	965.3	542.17	539.3	653.3	1192.6	0.4557
1000.0	985.3	544.61	542.4	649.4	1191.8	0.4456
1050.0	1035.3	550.57	550.0	639.9	1189.9	0.4218
1100.0	1085.3	556.31	557.4	630.4	1187.8	0.4001
1150.0	1135.3	561.86	564.6	621.0	1185.6	0.3802
1200.0	1185.3	567.22	571.7	611.7	1183.4	0.3619

- Continued -

calafish_00226

ROA_03459

Properties of Saturated Steam (Continued)

PRESSURE (LBS PER SQ IN.)		TEMPERATURE t (°F)	HEAT OF THE LIQUID (BTU/LB)	LATENT HEAT OF EVAPORATION (BTU/LB)	TOTAL HEAT OF STEAM H_g (BTU/LB)	SPECIFIC VOLUME $\overline{V}$ (CU FT PER LB)
Absolute P'	Gauge P					
1250.0	1235.3	572.42	578.6	602.4	1181.0	0.3450
1300.0	1285.3	577.46	585.4	593.2	1178.6	0.3293
1350.0	1335.3	582.35	592.1	584.0	1176.1	0.3148
1400.0	1385.3	587.10	598.7	574.7	1173.4	0.3012
1450.0	1435.3	591.73	605.2	565.5	1170.7	0.2884
1500.0	1485.3	596.23	611.6	556.3	1167.9	0.2765
1600.0	1585.3	604.90	624.1	538.0	1162.1	0.2548
1700.0	1685.3	613.15	636.3	519.6	1155.9	0.2354
1800.0	1785.3	621.03	648.3	501.1	1149.4	0.2179
1900.0	1885.3	628.58	660.1	482.4	1142.4	0.2021
2000.0	1985.3	635.82	671.7	463.4	1135.1	0.1878
2100.0	2085.3	642.77	683.3	444.1	1127.4	0.1746
2200.0	2185.3	649.46	694.8	424.4	1119.2	0.1625
2300.0	2285.3	655.91	706.5	403.9	1110.4	0.1513
2400.0	2385.3	662.12	718.4	382.7	1101.1	0.1407
2500.0	2485.3	668.13	730.6	360.5	1091.1	0.1307
2600.0	2585.3	673.94	743.0	337.2	1080.2	0.1213
2700.0	2685.3	679.55	756.2	312.1	1068.3	0.1123
2800.0	2785.3	684.99	770.1	284.7	1054.8	0.1035
2900.0	2885.3	690.26	785.4	253.6	1039.0	0.0947
3000.0	2985.3	695.36	802.5	217.8	1020.3	0.0858
3100.0	3085.3	700.31	825.0	168.1	993.1	0.0753
3200.0	3185.3	705.11	872.4	62.0	934.4	0.0580
3206.2	3191.5	705.40	902.7	0.0	902.7	0.0503

Refrigerant 717 (Ammonia)
Properties of Liquid and Saturated Vapor

TEMP. (°F)	PRESSURE		VOLUME (CU. FT./LB.)	DENSITY (LB./CU. FT.)	ENTHALPY† (BTU/LB.)		ENTROPY† BTU/(LB.)(°R)	
	psia	psig	Vapor V_g	Liquid $1/v_f$	Liquid h_f	Vapor h_g	Liquid s_f	Vapor s_g
−105	0.996	27.9*	223.2	45.71	−68.5	570.3	−0.1774	1.6243
−104	1.041	27.8*	214.2	45.67	−67.5	570.7	− .1744	1.6205
−103	1.087	27.7*	205.7	45.63	−66.4	571.2	− .1714	1.6167
−102	1.135	27.6*	197.6	45.59	−65.4	571.6	− .1685	1.6129
−101	1.184	27.5*	189.8	45.55	−64.3	572.1	− .1655	1.6092
−100	1.24	27.4*	182.4	45.52	−63.3	572.5	−0.1626	1.6055
−99	1.29	27.3*	175.3	45.47	−62.2	572.9	− .1597	1.6018
−98	1.34	27.2*	168.5	45.43	−61.2	573.4	− .1568	1.5982
−97	1.40	27.1*	162.1	45.40	−60.1	573.8	− .1539	1.5945
−96	1.46	26.9*	155.9	45.36	−59.1	574.3	− .1510	1.5910
−95	1.52	26.8*	150.0	45.32	−58.0	574.7	−0.1481	1.5874
−94	1.59	26.7*	144.3	45.28	−57.0	575.1	− .1452	1.5838
−93	1.65	26.6*	138.9	45.24	−55.9	575.6	− .1423	1.5803
−92	1.72	26.4*	133.8	45.20	−54.9	576.0	− .1395	1.5768
−91	1.79	26.3*	128.9	45.16	−53.8	576.5	− .1366	1.5734
−90	1.86	26.1*	124.1	45.12	−52.8	576.9	−0.1338	1.5699
−89	1.94	26.0*	119.6	45.08	−51.7	577.3	− .1309	1.5665
−88	2.02	25.8*	115.3	45.04	−50.7	577.8	− .1281	1.5631
−87	2.10	25.6*	111.1	45.00	−49.6	578.2	− .1253	1.5597
−86	2.18	25.5*	107.1	44.96	−48.6	578.6	− .1225	1.5564
−85	2.27	25.3*	103.3	44.92	−47.5	579.1	−0.1197	1.5531
−84	2.35	25.1*	99.68	44.88	−46.5	579.5	− .1169	1.5498
−83	2.45	24.9*	96.17	44.84	−45.4	579.9	− .1141	1.5465
−82	2.54	24.7*	92.81	44.80	−44.4	580.4	− .1113	1.5432
−81	2.64	24.5*	89.59	44.76	−43.3	580.8	− .1085	1.5400
−80	2.74	24.3*	86.50	44.73	−42.2	581.2	0.1057	1.5368
−79	2.84	24.1*	83.54	44.68	−41.2	581.6	− .1030	1.5336
−78	2.95	23.9*	80.69	44.64	−40.1	582.1	− .1002	1.5304
−77	3.06	23.7*	77.96	44.60	−39.1	582.5	− .0975	1.5273
−76	3.18	23.5*	75.33	44.56	−38.0	582.9	− .0947	1.5242
−75	3.29	23.2*	72.81	44.52	−37.0	583.3	−0.0920	1.5211
−74	3.42	23.0*	70.39	44.48	−35.9	583.8	− .0892	1.5180
−73	3.54	22.7*	68.06	44.44	−34.9	584.2	− .0865	1.5149
−72	3.67	22.4*	65.82	44.40	−33.8	584.6	− .0838	1.5119
−71	3.80	22.2*	63.67	44.36	−32.8	585.0	− .0811	1.5089
−70	3.94	21.9*	61.60	44.32	−31.7	585.5	−0.0784	1.5059
−69	4.08	21.6*	59.61	44.28	−30.7	585.9	− .0757	1.5029
−68	4.23	21.3*	57.69	44.24	−29.6	586.3	− .0730	1.4999
−67	4.38	21.0*	55.85	44.19	−28.6	586.7	− .0703	1.4970
−66	4.53	20.7*	54.08	44.15	−27.5	587.1	− .0676	1.4940
−65	4.69	20.4*	52.37	44.11	−26.5	587.5	−0.0650	1.4911
−64	4.85	20.0*	50.73	44.07	−25.4	588.0	− .0623	1.4883
−63	5.02	19.7*	49.14	44.03	−24.4	588.4	− .0596	1.4854
−62	5.19	19.4*	47.62	43.99	−23.3	588.8	− .0570	1.4826
−61	5.37	19.0*	46.15	43.95	−22.2	589.2	− .0543	1.4797
−60	5.55	18.8*	44.73	43.91	−21.2	589.6	− .0517	1.4769

*Inches of mercury below one standard atmosphere.
†Based on 0 for the saturated liquid at −40°F.

Refrigerant 717 (Ammonia)
Properties of Liquid and Saturated Vapor (Continued)

TEMP. (°F)	PRESSURE		VOLUME (CU. FT./LB.)	DENSITY (LB./CU. FT.)	ENTHALPY† (BTU/LB.)		ENTROPY† BTU/(LB.)(°R)	
	psia	psig	Vapor V_g	Liquid $1/v_f$	Liquid h_f	Vapor h_g	Liquid s_f	Vapor s_g
−59	5.74	18.2*	43.37	43.87	−20.1	590.0	−0.0490	1.4741
−58	5.93	17.8*	42.05	43.83	−19.1	590.4	− .0464	1.4713
−57	6.13	17.4*	40.79	43.78	−18.0	590.8	− .0438	1.4686
−56	6.33	17.0*	39.56	43.74	−17.0	591.2	− .0412	1.4658
−55	6.54	16.6*	38.38	43.70	−15.9	591.6	− .0386	1.4631
−54	6.75	16.2*	37.24	43.66	−14.8	592.1	−0.0360	1.4604
−53	6.97	15.7*	36.15	43.62	−13.8	592.4	− .0334	1.4577
−52	7.20	15.3*	35.09	43.58	−12.7	592.9	− .0307	1.4551
−51	7.43	14.8*	34.06	43.54	−11.7	593.2	− .0281	1.4524
−50	7.67	14.3*	33.08	43.49	−10.6	593.7	− .0256	1.4497
−49	7.91	13.8*	32.12	43.45	−9.6	594.0	−0.0230	1.4471
−48	8.16	13.3*	31.20	43.41	−8.5	594.4	− .0204	1.4445
−47	8.42	12.8*	30.31	43.37	−7.4	594.9	− .0179	1.4419
−46	8.68	12.2*	29.45	43.33	−6.4	595.2	− .0153	1.4393
−45	8.95	11.7*	28.62	43.28	−5.3	595.6	− .0127	1.4368
−44	9.23	11.1*	27.82	43.24	−4.3	596.0	−0.0102	1.4342
−43	9.51	10.6*	27.04	43.20	−3.2	596.4	− .0076	1.4317
−42	9.81	10.0*	26.29	43.16	−2.1	596.8	− .0051	1.4292
−41	10.10	9.3*	25.56	43.12	−1.1	597.2	− .0025	1.4267
−40	10.41	8.7*	24.86	43.08	0.0	597.6	.0000	1.4242
−39	10.72	8.1*	24.18	43.04	1.1	598.0	0.0025	1.4217
−38	11.04	7.4*	23.53	42.99	2.1	598.3	.0051	1.4193
−37	11.37	6.8*	22.89	42.95	3.2	598.7	.0076	1.4169
−36	11.71	6.1*	22.27	42.90	4.3	599.1	.0101	1.4144
−35	12.05	5.4*	21.68	42.86	5.3	599.5	.0126	1.4120
−34	12.41	4.7*	21.10	42.82	6.4	599.9	0.0151	1.4096
−33	12.77	3.9*	20.54	42.78	7.4	600.2	.0176	1.4072
−32	13.14	3.2*	20.00	42.73	8.5	600.6	.0201	1.4048
−31	13.52	2.4*	19.48	42.69	9.6	601.0	.0226	1.4025
−30	13.90	1.6*	18.97	42.65	10.7	601.4	.0250	1.4001
−29	14.30	0.8*	18.48	42.61	11.7	601.7	0.0275	1.3978
−28	14.71	0.0	18.00	42.57	12.8	602.1	.0300	1.3955
−27	15.12	0.4	17.54	42.54	13.9	602.5	.0325	1.3932
−26	15.55	0.8	17.09	42.48	14.9	602.8	.0350	1.3909
−25	15.98	1.3	16.66	42.44	16.0	603.2	.0374	1.3886
−24	16.24	1.7	16.24	42.40	17.1	603.6	0.0399	1.3863
−23	16.88	2.2	15.83	42.35	18.1	603.9	.0423	1.3840
−22	17.34	2.6	15.43	42.31	19.2	604.3	.0448	1.3818
−21	17.81	3.1	15.05	42.26	20.3	604.6	.0472	1.3796
−20	18.30	3.6	14.68	42.22	21.4	605.0	.0497	1.3774
−19	18.79	4.1	14.32	42.18	22.4	605.3	0.0521	1.3752
−18	19.30	4.6	13.97	42.13	23.5	605.7	.0545	1.3729
−17	19.81	5.1	13.62	42.09	24.6	606.1	.0570	1.3708
−16	20.34	5.6	13.29	42.04	25.6	606.4	.0594	1.3686
−15	20.88	6.2	12.97	42.00	26.7	606.7	.0618	1.3664
−14	21.43	6.7	12.66	41.96	27.8	607.1	.0642	1.3642

*Inches of mercury below one standard atmosphere.
†Based on 0 for the saturated liquid at −40°F.

calafish_00229

ROA_03462

Refrigerant 717 (Ammonia)
Properties of Liquid and Saturated Vapor (Continued)

TEMP. (°F)	PRESSURE		VOLUME (CU. FT./LB.)	DENSITY (LB./CU. FT.)	ENTHALPY† (BTU/LB.)		ENTROPY† BTU/(LB.)(°R)	
	psia	psig	Vapor V_g	Liquid $1/v_f$	Liquid h_f	Vapor h_g	Liquid s_f	Vapor s_g
−13	21.99	7.3	12.36	41.91	28.9	607.5	0.0666	1.3624
−12	22.56	7.9	12.06	41.87	30.0	607.8	.0690	1.3600
−11	23.15	8.5	11.78	41.82	31.0	608.1	.0714	1.3579
−10	23.74	9.0	11.50	41.78	32.1	608.5	.0738	1.3558
−9	24.35	9.7	11.23	41.74	33.2	608.8	.0762	1.3537
−8	24.97	10.3	10.97	41.69	34.3	609.2	0.0786	1.3516
−7	25.61	10.9	10.71	41.65	35.4	609.5	.0809	1.3493
−6	26.26	11.6	10.47	41.60	36.4	609.8	.0833	1.3474
−5	26.92	12.2	10.23	41.56	37.5	610.1	.0857	1.3454
−4	27.59	12.9	9.991	41.52	38.6	610.5	.0880	1.3433
−3	28.28	13.6	9.763	41.47	39.7	610.8	0.0909	1.3413
−2	28.98	14.3	9.541	41.43	40.7	611.1	.0928	1.3393
−1	29.69	15.0	9.326	41.38	41.8	611.4	.0951	1.3372
0	30.42	15.7	9.116	41.34	42.9	611.8	.0975	1.3352
1	31.16	16.5	8.912	41.29	44.0	612.1	.0998	1.3332
2	31.92	17.2	8.714	41.25	45.1	612.4	0.1022	1.3312
3	32.69	18.0	8.521	41.20	46.2	612.7	.1045	1.3292
4	33.47	18.8	8.333	41.16	47.2	613.0	.1069	1.3273
5‡	34.27	19.6	8.150	41.11	48.3	613.3	.1092	1.3253
6	35.09	20.4	7.971	41.07	49.4	613.6	.1115	1.3234
7	35.92	21.2	7.798	41.01	50.5	613.9	0.1138	1.3214
8	36.77	22.1	7.629	40.98	51.6	614.3	.1162	1.3195
9	37.63	22.9	7.464	40.93	52.7	614.6	.1185	1.3176
10	38.51	23.8	7.304	40.89	53.8	614.9	.1208	1.3157
11	39.40	24.7	7.148	40.84	54.9	615.2	.1231	1.3137
12	40.31	25.6	6.996	40.80	56.0	615.5	0.1254	1.3118
13	41.24	26.5	6.847	40.75	57.1	615.8	.1277	1.3099
14	42.18	27.5	6.703	40.71	58.2	616.1	.1300	1.3081
15	43.14	28.4	6.562	40.66	59.2	616.3	.1323	1.3062
16	44.12	29.4	6.425	40.61	60.3	616.6	.1346	1.3043
17	45.12	30.4	6.291	40.57	61.4	616.9	0.1369	1.3025
18	46.13	31.4	6.161	40.52	62.5	617.2	.1392	1.3006
19	47.16	32.5	6.034	40.48	63.6	617.5	.1415	1.2988
20	48.21	33.5	5.910	40.43	64.7	617.8	.1437	1.2969
21	49.28	34.6	5.789	40.38	65.8	618.0	.1460	1.2951
22	50.36	35.7	5.671	40.34	66.9	618.3	0.1483	1.2933
23	51.47	36.8	5.556	40.29	68.0	618.6	.1505	1.2915
24	52.59	37.9	5.443	40.25	69.1	618.9	.1528	1.2897
25	53.73	39.0	5.334	40.20	70.2	619.1	.1551	1.2879
26	54.90	40.2	5.227	40.15	71.3	619.4	.1573	1.2861
27	56.08	41.4	5.123	40.10	72.4	619.7	0.1596	1.2843
28	57.28	42.6	5.021	40.06	73.5	619.9	.1618	1.2823
29	58.50	43.8	4.922	40.01	74.6	620.2	.1641	1.2809
30	59.74	45.0	4.825	39.96	75.7	620.5	.1663	1.2790
31	61.00	46.3	4.730	39.91	76.8	620.7	.1686	1.2773
32	62.29	47.6	4.637	39.86	77.9	621.0	.1708	1.2755

*Inches of mercury below one standard atmosphere.
†Based on 0 for the saturated liquid at −40°F.
‡Standard cycle temperatures.

calafish_00230

ROA_03463

Refrigerant 717 (Ammonia)
Properties of Liquid and Saturated Vapor (Continued)

TEMP. (°F)	PRESSURE		VOLUME (CU. FT./LB.)	DENSITY (LB./CU. FT.)	ENTHALPY† (BTU/LB.)		ENTROPY† BTU/(LB.)(°R)	
	psia	psig	Vapor V_g	Liquid $1/v_f$	Liquid h_f	Vapor h_g	Liquid s_f	Vapor s_g
33	63.59	48.9	4.547	39.82	79.0	621.2	0.1730	1.2738
34	64.91	50.2	4.459	39.77	80.1	621.5	.1753	1.2721
35	66.26	51.6	4.373	39.72	81.2	621.7	.1775	1.2704
36	67.63	52.9	4.289	39.67	82.3	622.0	.1797	1.2686
37	69.02	54.3	4.207	39.63	83.4	622.2	.1819	1.2669
38	70.43	55.7	4.126	39.58	84.6	622.5	0.1841	1.2652
39	71.87	57.2	4.048	39.54	85.7	622.7	.1863	1.2635
40	73.32	58.6	3.971	39.49	86.8	623.0	.1885	1.2618
41	74.80	60.1	3.897	39.44	87.9	623.2	.1908	1.2602
42	76.31	61.6	3.823	39.39	89.0	623.4	.1930	1.2585
43	77.83	63.1	3.752	39.34	90.1	623.7	0.1952	1.2568
44	79.38	64.7	3.682	39.29	91.2	623.9	.1974	1.2552
45	80.96	66.3	3.614	39.24	92.3	624.1	.1996	1.2535
46	82.55	67.9	3.547	39.19	93.5	624.4	.2018	1.2518
47	84.18	69.5	3.481	39.14	94.6	624.6	.2040	1.2492
48	85.82	71.1	3.418	39.10	95.7	624.8	0.2062	1.2484
49	87.49	72.8	3.355	39.05	96.8	625.0	.2083	1.2469
50	89.19	74.5	3.294	39.00	97.9	625.2	.2105	1.2453
51	90.91	76.2	3.234	38.95	99.1	625.5	.2127	1.2437
52	92.66	78.0	3.176	38.90	100.2	625.7	.2149	1.2421
53	94.43	79.7	3.119	38.85	101.3	625.9	0.2171	1.2405
54	96.23	81.5	3.063	38.80	102.4	626.1	.2192	1.2382
55	98.06	83.4	3.008	38.75	103.5	626.3	.2214	1.2372
56	99.91	85.2	2.954	38.70	104.7	626.5	.2236	1.2357
57	101.8	87.1	2.902	38.65	105.8	626.7	.2257	1.2341
58	103.7	89.0	2.851	38.60	106.9	626.9	0.2279	1.2325
59	105.6	90.9	2.800	38.55	108.1	627.1	.2301	1.2310
60	107.6	92.9	2.751	38.50	109.2	627.3	.2322	1.2294
61	109.6	94.9	2.703	38.45	110.3	627.5	.2344	1.2273
62	111.6	96.9	2.656	38.40	111.5	627.7	.2365	1.2263
63	113.6	98.9	2.610	38.35	112.6	627.9	0.2387	1.2247
64	115.7	101.0	2.565	38.30	113.7	628.0	.2408	1.2231
65	117.8	103.1	2.520	38.25	114.8	628.2	.2430	1.2213
66	120.0	105.3	2.477	38.20	116.0	628.4	.2451	1.2201
67	122.1	107.4	2.435	38.15	117.1	628.6	.2473	1.2183
68	124.3	109.6	2.393	38.10	118.3	628.8	0.2494	1.2179
69	126.5	111.8	2.352	38.05	119.4	628.9	.2515	1.2165
70	128.8	114.1	2.312	38.00	120.5	629.1	.2537	1.2140
71	131.1	116.4	2.273	37.95	121.7	629.3	.2558	1.2125
72	133.4	118.7	2.235	37.90	122.8	629.4	.2579	1.2110
73	135.7	121.0	2.197	37.84	124.0	629.6	0.2601	1.2095
74	138.1	123.4	2.161	37.79	125.1	629.8	.2622	1.2080
75	140.5	125.8	2.125	37.74	126.2	629.9	.2643	1.2065
76	143.0	128.3	2.089	37.69	127.4	630.1	.2664	1.2050
77	145.4	130.7	2.055	37.64	128.5	630.2	.2685	1.2035
78	147.9	133.2	2.021	37.58	129.7	630.4	.2706	1.2020

*Inches of mercury below one standard atmosphere.
†Based on 0 for the saturated liquid at −40°F.

calafish_00231

ROA_03464

Refrigerant 717 (Ammonia)
Properties of Liquid and Saturated Vapor (Continued)

TEMP. (°F)	PRESSURE		VOLUME (CU. FT./LB.)	DENSITY (LB./CU. FT.)	ENTHALPY† (BTU/LB.)		ENTROPY† BTU/(LB.)(°R)	
	psia	psig	Vapor V_g	Liquid $1/v_f$	Liquid h_f	Vapor h_g	Liquid s_f	Vapor s_g
79	150.5	135.8	1.988	37.63	130.8	630.5	0.2728	1.2006
80	153.0	138.3	1.955	37.48	132.0	630.7	.2749	1.1991
81	155.6	140.9	1.923	37.43	133.1	630.8	.2769	1.1976
82	158.3	143.6	1.892	37.37	134.3	631.0	.2791	1.1962
83	161.0	146.3	1.861	37.32	135.4	631.1	.2812	1.1947
84	163.7	149.0	1.831	37.26	136.6	631.3	0.2833	1.1933
85	166.4	151.7	1.801	37.21	137.8	631.4	.2854	1.1918
86‡	169.2	154.5	1.772	37.16	138.9	631.5	.2875	1.1904
87	172.0	157.3	1.744	37.11	140.1	631.7	.2895	1.1889
88	174.8	160.1	1.716	37.05	141.2	631.8	.2917	1.1875
89	177.7	163.0	1.688	37.00	142.4	631.9	0.2937	1.1860
90	180.6	165.9	1.661	36.95	143.5	632.0	.2958	1.1846
91	183.6	168.9	1.635	36.89	144.7	632.1	.2979	1.1832
92	186.6	171.9	1.609	36.84	145.8	632.2	.3000	1.1818
93	189.6	174.9	1.584	36.78	147.0	632.3	.3021	1.1804
94	192.7	178.0	1.559	36.73	148.2	632.5	0.3041	1.1789
95	195.8	181.1	1.534	36.67	149.4	632.6	.3062	1.1775
96	198.9	184.2	1.510	36.62	150.5	632.6	.3083	1.1761
97	202.1	187.4	1.487	36.56	151.7	632.8	.3104	1.1747
98	205.3	190.6	1.464	36.51	152.9	632.9	.3125	1.1733
99	208.6	193.9	1.441	36.45	154.0	632.9	0.3145	1.1719
100	211.9	197.2	1.419	36.40	155.2	633.0	.3166	1.1705
101	215.2	200.5	1.397	36.34	156.4	633.1	.3187	1.1691
102	218.6	203.9	1.375	36.29	157.6	633.2	.3207	1.1677
103	222.0	207.3	1.354	36.23	158.7	633.3	.3228	1.1663
104	225.4	210.7	1.334	36.18	159.9	633.4	0.3248	1.1649
105	228.9	214.2	1.313	36.12	161.1	633.4	.3269	1.1635
106	232.5	217.8	1.293	36.06	162.3	633.5	.3289	1.1621
107	236.0	221.3	1.274	36.01	163.5	633.6	.3310	1.1607
108	239.7	225.0	1.254	35.95	164.6	633.6	.3330	1.1593
109	243.3	228.6	1.235	35.90	165.8	633.7	0.3351	1.1580
110	247.0	232.3	1.217	35.84	167.0	633.7	.3372	1.1566
111	250.8	236.1	1.198	35.78	168.2	633.8	.3392	1.1552
112	254.5	239.8	1.180	35.72	169.4	633.8	.3413	1.1538
113	258.4	243.7	1.163	35.67	170.6	633.9	.3433	1.1524
114	262.2	247.5	1.145	35.61	171.8	633.9	0.3453	1.1510
115	266.2	251.5	1.128	35.55	173.0	633.9	.3474	1.1497
116	270.1	255.4	1.112	35.49	174.2	634.0	.3495	1.1483
117	274.1	259.4	1.095	35.43	175.4	634.0	.3515	1.1469
118	278.2	263.5	1.079	35.38	176.6	634.0	.3536	1.1455
119	282.3	267.6	1.063	35.32	177.8	634.0	.3556	1.1441
120	286.4	271.7	1.047	35.26	179.0	634.0	0.3576	1.1427
121	290.6	275.9	1.032	35.20	180.2	634.0	.3597	1.1414
122	294.8	280.1	1.017	35.14	181.4	634.0	.3618	1.1400
123	299.1	284.4	1.002	35.08	182.6	634.0	.3638	1.1386
124	303.4	288.7	0.987	35.02	183.9	634.0	.3659	1.1372
125	307.8	293.1	0.973	34.96	185.1	634.0	.3679	1.1358

*Inches of mercury below one standard atmosphere.
†Based on 0 for the saturated liquid at −40°F.
‡Standard cycle temperatures.

calafish_00232

ROA_03465

Properties of Superheated Steam

$\overline{V}$ = specific volume, cubic feet per pound

h_g = total heat of steam, Btu per pound

PRESSURE (LBS PER SQ IN.) Absolute P'	Gauge P	SAT. TEMP. t		TOTAL TEMPERATURE—DEGREES FAHRENHEIT (t) 360°	400°	440°	480°	500°	600°	700°	800°	900°	1000°	1200°
14.696	0.0	212.00	$\overline{V}$	33.03	34.68	36.32	37.96	38.78	42.88	46.94	51.00	55.07	59.13	67.25
			h_g	1221.1	1239.9	1258.8	1277.6	1287.1	1334.8	1383.2	1432.3	1482.3	1533.1	1637.5
20.0	5.3	227.96	$\overline{V}$	24.21	25.43	26.65	27.88	28.46	31.47	34.47	37.46	40.45	43.44	49.41
			h_g	1220.3	1239.2	1258.2	1277.1	1286.6	1334.4	1382.9	1432.1	1482.1	1533.0	1637.4
30.0	15.3	250.33	$\overline{V}$	16.072	16.897	17.714	18.528	18.933	20.95	22.96	24.96	26.96	28.95	32.93
			h_g	1218.6	1237.9	1257.0	1276.2	1285.7	1333.8	1382.4	1431.7	1481.8	1532.7	1637.2
40.0	25.3	267.25	$\overline{V}$	12.001	12.628	13.247	13.862	14.168	15.688	17.198	18.702	20.20	21.70	24.69
			h_g	1216.9	1236.5	1255.9	1275.2	1284.8	1333.1	1381.9	1431.3	1481.4	1532.4	1637.0
50.0	35.3	281.01	$\overline{V}$	9.557	10.065	10.567	11.062	11.309	12.532	13.744	14.950	16.152	17.352	19.747
			h_g	1215.2	1235.1	1254.7	1274.2	1283.9	1332.5	1381.4	1430.9	1481.1	1532.1	1636.8
60.0	45.3	292.71	$\overline{V}$	7.927	8.357	8.779	9.196	9.403	10.427	11.441	12.449	13.452	14.454	16.451
			h_g	1213.4	1233.6	1253.5	1273.2	1283.0	1331.8	1380.9	1430.5	1480.8	1531.9	1636.6
70.0	55.3	302.92	$\overline{V}$	6.762	7.136	7.502	7.863	8.041	8.924	9.796	10.662	11.524	12.383	14.097
			h_g	1211.5	1232.1	1252.3	1272.2	1282.0	1331.1	1380.4	1430.1	1480.5	1531.6	1636.3
80.0	65.3	312.03	$\overline{V}$	5.888	6.220	6.544	6.862	7.020	7.797	8.562	9.322	10.077	10.830	12.332
			h_g	1209.7	1230.7	1251.1	1271.1	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3	1636.2
90.0	75.3	320.27	$\overline{V}$	5.208	5.508	5.799	6.084	6.225	6.920	7.603	8.279	8.952	9.623	10.959
			h_g	1207.7	1229.1	1249.8	1270.1	1280.1	1329.8	1379.4	1429.3	1479.8	1531.0	1635.9
100.0	85.3	327.81	$\overline{V}$	4.663	4.937	5.202	5.462	5.589	6.218	6.835	7.446	8.052	8.656	9.860
			h_g	1205.7	1227.6	1248.6	1269.0	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8	1635.7
120.0	105.3	341.25	$\overline{V}$	3.844	4.081	4.307	4.527	4.636	5.165	5.683	6.195	6.702	7.207	8.212
			h_g	1201.6	1224.4	1246.0	1266.9	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2	1635.3

- Continued -

calafish_00233

140.0	125.3	353.02	$\overline{V}$ h_g	3.258 1197.3	3.468 1221.1	3.667 1243.3	3.860 1264.7	3.954 1275.2	4.413 1326.4	4.861 1376.8	5.301 1427.3	5.738 1478.2	6.172 1529.7	7.035 1634.9
160.0	145.3	363.53	$\overline{V}$ h_g	... ...	3.008 1217.6	3.187 1240.6	3.359 1262.4	3.443 1273.1	3.849 1325.0	4.244 1375.7	4.631 1426.4	5.015 1477.5	5.396 1529.1	6.152 1634.5
180.0	165.3	373.06	$\overline{V}$ h_g	... ...	2.649 1214.0	2.813 1237.8	2.969 1260.2	3.044 1271.0	3.411 1323.5	3.764 1374.7	4.110 1425.6	4.452 1476.8	4.792 1528.6	5.466 1634.1
200.0	185.3	381.79	$\overline{V}$ h_g	... ...	2.361 1210.3	2.513 1234.8	2.656 1257.8	2.726 1268.9	3.060 1322.1	3.390 1373.6	3.693 1424.8	4.002 1476.2	4.309 1528.0	4.917 1633.7
220.0	205.3	389.86	$\overline{V}$ h_g	... ...	2.125 1206.5	2.267 1231.9	2.400 1255.4	2.465 1266.7	2.772 1320.7	3.066 1372.6	3.352 1424.0	3.634 1475.5	3.913 1527.5	4.467 1633.3
240.0	225.3	397.37	$\overline{V}$ h_g	... ...	1.9276 1202.5	2.062 1228.8	2.187 1253.0	2.247 1264.5	2.533 1319.2	2.804 1371.5	3.068 1423.2	3.327 1474.8	3.584 1526.9	4.093 1632.9
260.0	245.3	404.42	$\overline{V}$ h_g	... ...	... ...	1.8882 1225.7	2.006 1250.5	2.063 1262.3	2.330 1317.7	2.582 1370.4	2.827 1422.3	3.067 1474.2	3.305 1526.3	3.776 1632.5
280.0	265.3	411.05	$\overline{V}$ h_g	... ...	... ...	1.7388 1222.4	1.8512 1247.9	1.9047 1260.0	2.156 1316.2	2.392 1369.4	2.621 1421.5	2.845 1473.5	3.066 1525.8	3.504 1632.1
300.0	285.3	417.33	$\overline{V}$ h_g	... ...	... ...	1.6090 1219.1	1.7165 1245.3	1.7675 1257.6	2.005 1314.7	2.227 1368.3	2.442 1420.6	2.652 1472.8	2.859 1525.2	3.269 1631.7
320.0	305.3	423.29	$\overline{V}$ h_g	... ...	... ...	1.4950 1215.6	1.5985 1242.6	1.6472 1255.2	1.8734 1313.2	2.083 1367.2	2.285 1419.8	2.483 1472.1	2.678 1524.7	3.063 1631.3
340.0	325.3	428.97	$\overline{V}$ h_g	... ...	... ...	1.3941 1212.1	1.4941 1239.9	1.5410 1252.8	1.7569 1311.6	1.9562 1366.1	2.147 1419.0	2.334 1471.5	2.518 1524.1	2.881 1630.9
360.0	345.3	434.40	$\overline{V}$ h_g	... ...	... ...	1.3041 1208.4	1.4012 1237.1	1.4464 1250.3	1.6533 1310.1	1.8431 1365.0	2.025 1418.1	2.202 1470.8	2.376 1523.5	2.719 1630.5

- Continued -

calafish_00234

ROA_03467

Properties of Superheated Steam (Continued)

$\bar{V}$ = specific volume, cubic feet per pound

h_g = total heat of steam, Btu per pound

PRESSURE (LBS PER SQ IN.)		SAT. TEMP.		TOTAL TEMPERATURE—DEGREES FAHRENHEIT (t)										
Absolute P'	Gauge P	t		500°	540°	600°	640°	660°	700°	740°	800°	900°	1000°	1200°
380.0	365.3	439.60	$\bar{V}$	1.3616	1.4444	1.5605	1.6345	1.6707	1.7419	1.8118	1.9149	2.083	2.249	2.575
			h_g	1247.7	1273.1	1308.5	1331.0	1342.0	1363.8	1385.3	1417.3	1470.1	1523.0	1630.0
400.0	385.3	444.59	$\bar{V}$	1.2851	1.3652	1.4770	1.5480	1.5827	1.6508	1.7177	1.8161	1.9767	2.134	2.445
			h_g	1245.1	1271.0	1306.9	1329.6	1340.8	1362.7	1384.3	1416.4	1469.4	1522.4	1629.6
420.0	405.3	449.39	$\bar{V}$	1.2158	1.2935	1.4014	1.4697	1.5030	1.5684	1.6324	1.7267	1.8802	2.031	2.327
			h_g	1242.5	1268.9	1305.3	1328.3	1339.5	1361.6	1383.3	1415.5	1468.7	1521.9	1629.2
440.0	425.3	454.02	$\bar{V}$	1.1526	1.2282	1.3327	1.3984	1.4306	1.4934	1.5549	1.6454	1.7925	1.9368	2.220
			h_g	1239.8	1266.7	1303.6	1326.9	1338.2	1360.4	1382.3	1414.7	1468.1	1521.3	1628.8
460.0	445.3	458.50	$\bar{V}$	1.0948	1.1685	1.2698	1.3334	1.3644	1.4250	1.4842	1.5711	1.7124	1.8608	2.122
			h_g	1237.0	1264.5	1302.0	1325.4	1336.9	1359.3	1381.3	1413.8	1467.4	1520.7	1628.4
480.0	465.3	462.82	$\bar{V}$	1.0417	1.1138	1.2122	1.2737	1.3038	1.3622	1.4193	1.5031	1.6390	1.7720	2.033
			h_g	1234.2	1262.3	1300.3	1324.0	1335.6	1358.2	1380.3	1412.9	1466.7	1520.2	1628.0
500.0	485.3	467.01	$\bar{V}$	0.9927	1.0633	1.1591	1.2188	1.2478	1.3044	1.3596	1.4405	1.5715	1.6996	1.9504
			h_g	1231.3	1260.0	1298.6	1322.6	1334.2	1357.0	1379.3	1412.1	1466.0	1519.6	1627.6
520.0	505.3	471.07	$\bar{V}$	0.9473	1.0166	1.1101	1.1681	1.1962	1.2511	1.3045	1.3826	1.5091	1.6326	1.8743
			h_g	1228.3	1257.7	1296.9	1321.1	1332.9	1355.8	1378.2	1411.2	1465.3	1519.0	1627.2
540.0	525.3	475.01	$\bar{V}$	0.9052	0.9733	1.0646	1.1211	1.1485	1.2017	1.2535	1.3291	1.4514	1.5707	1.8039
			h_g	1225.3	1255.4	1295.2	1319.7	1331.5	1354.6	1377.2	1410.3	1464.6	1518.5	1626.8
560.0	545.3	478.85	$\bar{V}$	0.8659	0.9330	1.0224	1.0775	1.1041	1.1558	1.2060	1.2794	1.3978	1.5132	1.7385
			h_g	1222.2	1253.0	1293.4	1318.2	1330.2	1353.5	1376.1	1409.4	1463.9	1517.9	1626.4
580.0	565.3	482.58	$\bar{V}$	0.8291	0.8954	0.9830	1.0368	1.0627	1.1331	1.1619	1.2331	1.3479	1.4596	1.6776
			h_g	1219.0	1250.5	1291.7	1316.7	1328.8	1352.3	1375.1	1408.6	1463.2	1517.3	1626.0

calafish_00235

ROA_03468

600.0	585.3	486.21	$\overline{V}$	0.7947	0.8602	0.9463	0.9988	1.0241	1.0732	1.1207	1.1899	1.3013	1.4096	1.6208
			h_g	1215.7	1248.1	1289.9	1315.2	1327.4	1351.1	1374.0	1407.7	1462.5	1516.7	1625.5
620.0	605.3	489.75	$\overline{V}$	0.7624	0.8272	0.9118	0.9633	0.9880	1.0358	1.0821	1.1494	1.2577	1.3828	1.5876
			h_g	1212.4	1245.5	1288.1	1313.7	1326.0	1349.9	1373.0	1406.8	1461.8	1516.2	1625.1
640.0	625.3	493.21	$\overline{V}$	0.7319	0.7963	0.8795	0.9299	0.9541	1.0008	1.0459	1.1115	1.2168	1.3190	1.5178
			h_g	1209.0	1243.0	1286.2	1312.2	1324.6	1348.6	1371.9	1405.9	1461.1	1515.6	1624.7
660.0	645.3	496.58	$\overline{V}$	0.7032	0.7670	0.8491	0.8985	0.9222	0.9679	1.0119	1.0759	1.1784	1.2778	1.4709
			h_g	1205.4	1240.4	1284.4	1310.6	1323.2	1347.4	1370.8	1405.0	1460.4	1515.0	1624.3
680.0	665.3	499.88	$\overline{V}$	0.6759	0.7395	0.8205	0.8690	0.8922	0.9369	0.9800	1.0424	1.1423	1.2390	1.4269
			h_g	1201.8	1237.7	1282.5	1309.1	1321.7	1346.2	1369.8	1404.1	1459.7	1514.5	1623.9
700.0	685.3	503.10	$\overline{V}$	...	0.7134	0.7934	0.8411	0.8639	0.9077	0.9498	1.0108	1.1082	1.2024	1.3853
			h_g	...	1235.0	1280.6	1307.5	1320.3	1345.0	1368.7	1403.2	1459.0	1513.9	1623.5
750.0	735.3	510.86	$\overline{V}$	...	0.6540	0.7319	0.7778	0.7996	0.8414	0.8813	0.9391	1.0310	1.1196	1.2912
			h_g	...	1227.9	1275.7	1303.5	1316.6	1341.8	1366.0	1400.9	1457.2	1512.4	1622.4
800.0	785.3	518.23	$\overline{V}$	...	0.6015	0.6779	0.7223	0.7433	0.7833	0.8215	0.8763	0.9633	1.0470	1.2088
			h_g	...	1220.5	1270.7	1299.4	1312.9	1338.6	1363.2	1398.6	1455.4	1511.0	1621.4
850.0	835.3	525.26	$\overline{V}$	...	0.5546	0.6301	0.6732	0.6934	0.7320	0.7685	0.8209	0.9037	0.9830	1.1360
			h_g	...	1212.7	1265.5	1295.2	1309.0	1335.4	1360.4	1396.3	1453.6	1509.5	1620.4
900.0	885.3	531.98	$\overline{V}$	...	0.5124	0.5873	0.6294	0.6491	0.6863	0.7215	0.7716	0.8506	0.9262	1.0714
			h_g	...	1204.4	1260.1	1290.9	1305.1	1332.1	1357.5	1393.9	1451.8	1508.1	1619.3
950.0	935.3	538.42	$\overline{V}$	...	0.4740	0.5489	0.5901	0.6092	0.6453	0.6793	0.7275	0.8031	0.8753	1.0136
			h_g	...	1195.5	1254.6	1286.4	1301.1	1328.7	1354.7	1391.6	1450.0	1506.6	1618.3
1000.0	985.3	544.61	$\overline{V}$	...	...	0.5140	0.5546	0.5733	0.6084	0.6413	0.6878	0.7604	0.8294	0.9615
			h_g	...	...	1248.8	1281.9	1297.0	1325.3	1351.7	1389.2	1448.2	1505.1	1617.3

- Continued -

calafish_00236

ROA_03469

Properties of Superheated Steam (Continued)

$\overline{V}$ = specific volume, cubic feet per pound

h_g = total heat of steam, Btu per pound

PRESSURE (LBS PER SQ IN.)		SAT. TEMP.		TOTAL TEMPERATURE—DEGREES FAHRENHEIT (t)										
Absolute P'	Gauge P	t		660°	700°	740°	760°	780°	800°	860°	900°	1000°	1100°	1200°
1100.0	1085.3	556.31	$\overline{V}$	0.5110	0.5445	0.5755	0.5904	0.6049	0.6191	0.6601	0.6866	0.7503	0.8117	0.8716
			h_g	1288.5	1318.3	1345.8	1358.9	1371.7	1384.3	1420.8	1444.5	1502.2	1558.8	1615.2
1200.0	1185.3	567.22	$\overline{V}$	0.4586	0.4909	0.5206	0.5347	0.5484	0.5617	0.6003	0.6250	0.6843	0.7412	0.7967
			h_g	1279.6	1311.0	1339.6	1353.2	1366.4	1379.3	1416.7	1440.7	1499.2	1556.4	1613.1
1300.0	1285.3	577.46	$\overline{V}$	0.4139	0.4454	0.4739	0.4874	0.5004	0.5131	0.5496	0.5728	0.6284	0.6816	0.7333
			h_g	1270.2	1303.4	1333.3	1347.3	1361.0	1374.3	1412.5	1437.0	1496.2	1553.9	1611.0
1400.0	1385.3	587.10	$\overline{V}$	0.3753	0.4062	0.4338	0.4468	0.4593	0.4714	0.5061	0.5281	0.5805	0.6305	0.6789
			h_g	1260.3	1295.5	1326.7	1341.3	1355.4	1369.1	1408.2	1433.1	1493.2	1551.4	1608.9
1500.0	1485.3	596.23	$\overline{V}$	0.3413	0.3719	0.3989	0.4114	0.4235	0.4352	0.4684	0.4893	0.5390	0.5862	0.6318
			h_g	1249.8	1287.2	1320.0	1335.2	1349.7	1363.8	1403.9	1429.3	1490.1	1548.9	1606.8
1600.0	1585.3	604.90	$\overline{V}$	0.3112	0.3417	0.3682	0.3804	0.3921	0.4034	0.4353	0.4553	0.5027	0.5474	0.5906
			h_g	1238.7	1278.7	1313.0	1328.8	1343.9	1358.4	1399.5	1425.3	1487.0	1546.4	1604.6
1700.0	1685.3	613.15	$\overline{V}$	0.2842	0.3148	0.3410	0.3529	0.3643	0.3753	0.4061	0.4253	0.4706	0.5132	0.5542
			h_g	1226.8	1269.7	1305.8	1322.3	1337.9	1352.9	1395.0	1421.4	1484.0	1543.8	1602.5
1800.0	1785.3	621.03	$\overline{V}$	0.2597	0.2907	0.3166	0.3284	0.3395	0.3502	0.3801	0.3986	0.4421	0.4828	0.5218
			h_g	1214.0	1260.3	1298.4	1315.5	1331.8	1347.2	1390.4	1417.4	1480.8	1541.3	1600.4
1900.0	1885.3	628.58	$\overline{V}$	0.2371	0.2688	0.2947	0.3063	0.3173	0.3277	0.3568	0.3747	0.4165	0.4556	0.4929
			h_g	1200.2	1250.4	1290.6	1308.6	1325.4	1341.5	1385.8	1413.3	1477.7	1538.8	1598.2
2000.0	1985.3	635.82	$\overline{V}$	0.2161	0.2489	0.2748	0.2863	0.2972	0.3074	0.3358	0.3532	0.3935	0.4311	0.4668
			h_g	1184.9	1240.0	1282.6	1301.4	1319.0	1335.5	1381.2	1409.2	1474.5	1536.2	1596.1
2100.0	2085.3	642.77	$\overline{V}$	0.1962	0.2306	0.2567	0.2682	0.2789	0.2890	0.3167	0.3337	0.3727	0.4089	0.4433
			h_g	1167.7	1229.0	1274.3	1294.0	1312.3	1329.5	1376.4	1405.0	1471.4	1533.6	1593.9

- Continued -

ROA_03470

calafish_00237_

2200.0	2185.3	649.46	$\overline{V}$ h_g	0.1768 1147.8	0.2135 1217.4	0.2400 1265.7	0.2514 1286.3	0.2621 1305.4	0.2721 1323.3	0.2994 1371.5	0.3159 1400.8	0.3538 1468.2	0.3887 1531.1	0.4218 1591.8
2300.0	2285.3	655.91	$\overline{V}$ h_g	0.1575 1123.8	0.1978 1204.9	0.2247 1256.7	0.2362 1278.4	0.2468 1298.4	0.2567 1316.9	0.2835 1366.6	0.2997 1396.5	0.3365 1464.9	0.3703 1528.5	0.4023 1589.6
2400.0	2385.3	662.12	$\overline{V}$ h_g	... ...	0.1828 1191.5	0.2105 1247.3	0.2221 1270.2	0.2327 1291.1	0.2425 1310.3	0.2689 1361.6	0.2848 1392.2	0.3207 1461.7	0.3534 1525.9	0.3843 1587.4
2500.0	2485.3	668.13	$\overline{V}$ h_g	... ...	0.1686 1176.8	0.1973 12-7.6	0.2090 1261.8	0.2196 1283.6	0.2294 1303.6	0.2555 1356.5	0.2710 1387.8	0.3061 1458.4	0.3379 1523.2	0.3678 1585.3
2600.0	2585.3	673.94	$\overline{V}$ h_g	... ...	0.1549 1160.6	0.1849 1227.3	0.1987 1252.9	0.2074 1275.8	0.2172 1296.8	0.2431 1351.4	0.2584 1383.4	0.2926 1455.1	0.3236 1520.6	0.3526 1583.1
2700.0	2685.3	679.55	$\overline{V}$ h_g	... ...	0.1415 1142.5	0.1732 1216.5	0.1853 1243.8	0.1960 1267.9	0.2059 1289.7	0.2315 1346.1	0.2466 1378.9	0.2801 1451.8	0.3103 1518.0	0.3385 1580.9
2800.0	2785.3	684.99	$\overline{V}$ h_g	... ...	0.1281 1121.4	0.1622 1205.1	0.1745 1234.2	0.1854 1259.6	0.1953 1282.4	0.2208 1340.8	0.2356 1374.3	0.2685 1448.5	0.2979 1515.4	0.3254 1578.7
2900.0	2885.3	690.26	$\overline{V}$ h_g	... ...	0.1143 1095.9	0.1517 1193.0	0.1644 1224.3	0.1754 1251.1	0.1853 1274.9	0.2108 1336.3	0.2254 1369.7	0.2577 1445.1	0.2864 1512.7	0.3132 1576.5
3000.0	2985.3	695.36	$\overline{V}$ h_g	... ...	0.0984 1060.7	0.1416 1180.1	0.1548 1213.8	0.1660 1242.2	0.1760 1267.2	0.2014 1329.7	0.2159 1365.0	0.2476 1441.8	0.2757 1510.0	0.3018 1574.3
3100.0	3085.3	700.31	$\overline{V}$ h_g	... ...	... ...	0.1320 1166.2	0.1456 1202.9	0.1571 1233.0	0.1672 1259.3	0.1926 1324.1	0.2070 1360.3	0.2382 1438.4	0.2657 1507.4	0.2911 1572.1
3200.0	3185.3	705.11	$\overline{V}$ h_g	... ...	... ...	0.1226 1151.1	0.1369 1191.4	0.1486 1223.5	0.1589 1251.1	0.1843 1318.3	0.1986 1355.5	0.2293 1434.9	0.2563 1504.7	0.2811 1569.9
3208.2	3191.5	705.40	$\overline{V}$ h_g	... ...	... ...	0.1220 1150.2	0.1363 1190.6	0.1480 1222.9	0.1583 1250.5	0.1838 1317.9	0.1981 1355.2	0.2288 1434.7	0.2557 1504.5	0.2806 1569.8

calafish_00238

ROA_03471

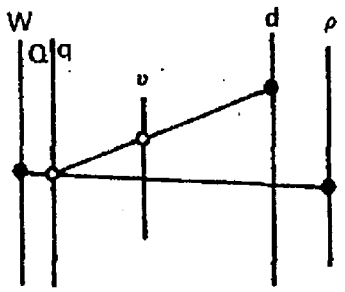
Velocity of Liquids in Pipe

The mean velocity of any flowing liquid can be calculated from the following formula, or, from the nomograph on the opposite page. The nomograph is a graphical solution of the formula.

$$v = 183.3\,\frac{q}{d^2} = 0.408\,\frac{Q}{d^2} = 0.0509\,\frac{W}{d^2\rho}$$

(For values of d, see pages 166-174.)

The pressure drop per 100 feet and the velocity in Schedule 40 pipe, for water at 60°F, have been calculated for commonly used flow rates for pipe sizes of 1/8 to 24-inch; these values are tabulated on pages 156-159.



Example 1

Given: No. 3 Fuel Oil of 0.898 specific gravity at 60°F flows through a 2-inch Schedule 40 pipe at the rate of 45,000 pounds per hour.

Find: The rate of flow in gallons per minute and the mean velocity in the pipe.

Solution:

1. ρ = 56.02 = weight density in pounds per cubic foot (specific gravity of fluid times weight density of water at same temperature.)

	Connect		Read
2.	W = 45,000	ρ = 56.02	Q = 100
3.	Q = 100	2" Sched 40	v = 10

Example 2

Given: Maximum flow rate of a liquid will be 300 gallons per minute with maximum velocity limited to 12 feet per second through Schedule 40 pipe.

Find: The smallest suitable pipe size and the velocity through the pipe.

Solution:

	Connect		Read
1.	Q = 300	v = 12	d = 3.2
2.	3-1/2" Schedule 40 pipe suitable		
3.	Q = 300	3-1/2" Sched 40	v = 10

Reasonable Velocities For the Flow of Water through Pipe

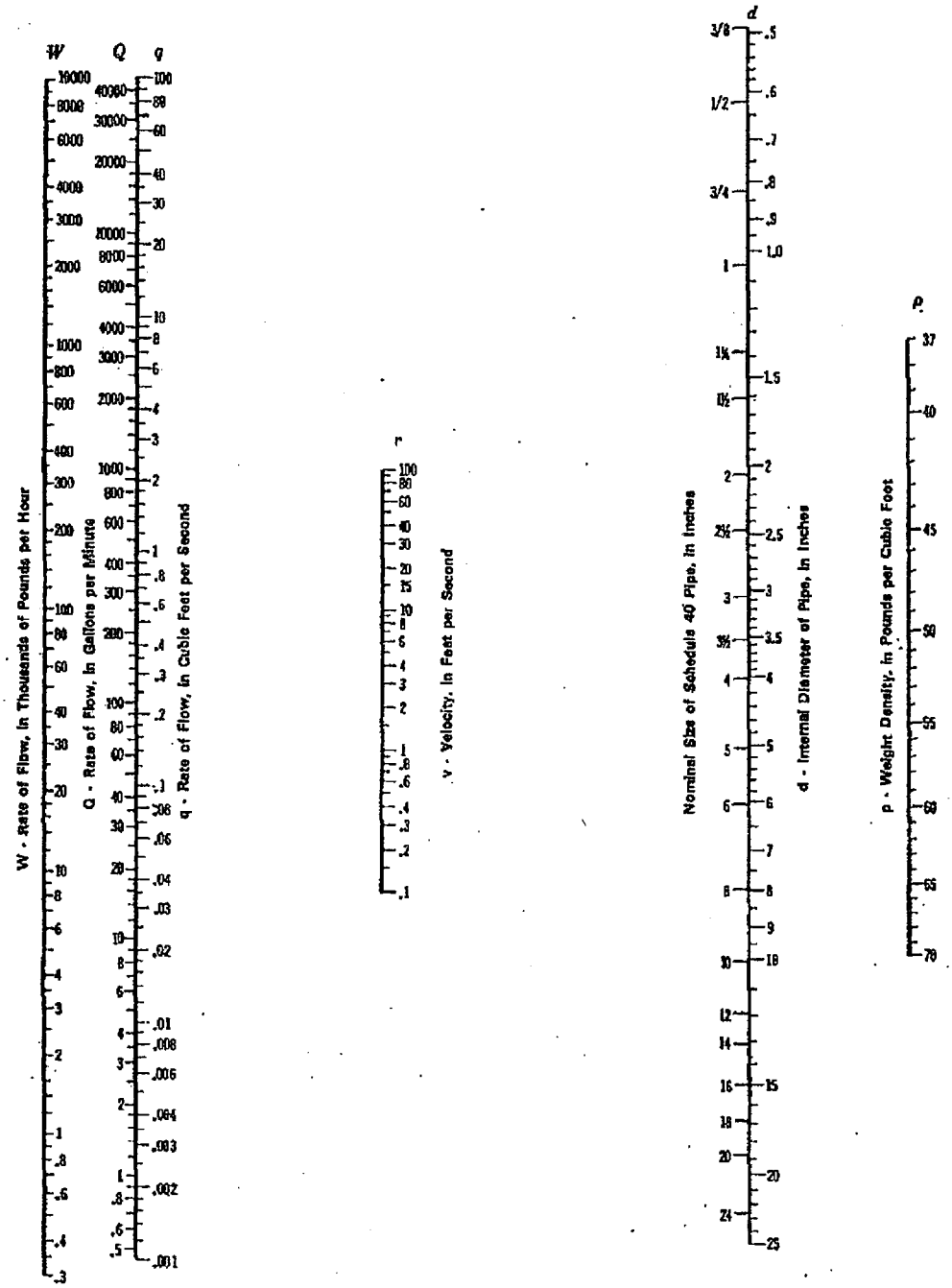
Service Condition	Reasonable Velocity (feet per second)
Boiler Feed	8 to 15
Pump Suction and Drain Lines	4 to 7
General Service	4 to 10
City	to 7

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00239

ROA_03472

Velocity of Liquids in Pipe (Continued)



Flow of Water Through Schedule 40 Steel Pipe

DISCHARGE		PRESSURE DROP PER 100 FEET AND VELOCITY IN SCHEDULE 40 PIPE FOR WATER AT 60 F															
Gallons per Minute	Cubic Ft. per Second	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)
		1/8"		1/4"		3/8"		1/2"									
.2	0.000446	1.13	1.86	0.616	0.359												
.3	0.000668	1.69	4.22	0.924	0.903	0.504	0.159	0.317	0.061	3/4"							
.4	0.000891	2.26	6.98	1.23	1.61	0.672	0.345	0.422	0.086								
.5	0.00111	2.82	10.5	1.54	2.39	0.840	0.539	0.528	0.167	0.301	0.033						
.6	0.00134	3.39	14.7	1.85	3.29	1.01	0.751	0.633	0.240	0.361	0.041						
.8	0.00178	4.52	25.0	2.46	5.44	1.34	1.25	0.844	0.408	0.481	0.102	1"					
1	0.00223	5.65	37.2	3.08	8.28	1.68	1.85	1.06	0.600	0.602	0.155	0.371	0.048	1-1/4"			
2	0.00446	11.29	134.4	6.16	30.1	3.36	6.58	2.11	2.10	1.20	0.526	0.743	0.164	0.429	0.044	1-1/2"	
3	0.00668			9.25	64.1	5.04	13.9	3.17	4.33	1.81	1.09	1.114	0.336	0.644	0.090	0.473	0.043
4	0.00891			12.33	111.2	6.72	23.9	4.22	7.42	2.41	1.83	1.49	0.565	0.858	0.150	0.630	0.071
5	0.01114	2"				8.40	36.7	5.28	11.2	3.01	2.75	1.86	0.835	1.073	0.223	0.788	0.104
6	0.01337	0.574	0.044	2-1/2"		10.08	51.9	6.33	15.8	3.61	3.84	2.23	1.17	1.29	0.309	0.946	0.145
8	0.01782	0.765	0.073			13.44	91.1	8.45	27.7	4.81	6.60	2.97	1.99	1.72	0.518	1.26	0.241
10	0.02228	0.956	0.108	0.670	0.046	3"		10.56	42.4	6.02	9.99	3.71	2.99	2.15	0.774	1.58	0.361
15	0.03342	1.43	0.224	1.01	0.094					9.03	21.6	5.57	6.36	3.22	1.63	2.37	0.755
20	0.04456	1.91	0.376	1.34	0.158	0.868	0.056	3-1/2"		12.03	37.8	7.43	10.9	4.29	2.78	3.16	1.28
25	0.05570	2.39	0.561	1.68	0.234	1.09	0.083	0.812	0.041	4"		9.28	16.7	5.37	4.22	3.94	1.93
30	0.06684	2.87	0.786	2.01	0.327	1.30	0.114	0.974	0.056			11.14	23.8	6.44	5.92	4.73	2.72
35	0.07798	3.35	1.05	2.35	0.436	1.52	0.151	1.14	0.071	0.882	0.041	12.99	32.2	7.51	7.90	5.52	3.64
40	0.08912	3.83	1.35	2.68	0.556	1.74	0.192	1.30	0.095	1.01	0.052	14.85	41.5	8.59	10.24	6.30	4.65
45	0.1003	4.30	1.67	3.02	0.668	1.95	0.239	1.46	0.117	1.13	0.064			9.67	12.80	7.09	5.85

- Continued -

calafish_00241

(Continued from facing page.)

		(2")		(2-1/2")		(3")		(3-1/2")		(4")				(1-1/4")		(1-1/2")	
50	0.1114	4.78	2.03	3.35	0.839	2.17	0.288	1.62	0.142	1.26	0.076	5"		10.74	15.66	7.88	7.15
60	0.1337	5.74	2.87	4.02	1.18	2.60	0.46	1.95	0.204	1.51	0.107			12.89	22.2	9.47	10.21
70	0.1560	6.70	3.84	4.69	1.59	3.04	0.540	2.27	0.261	1.76	0.143	1.12	0.047			11.05	13.71
80	0.1782	7.65	4.97	5.36	2.03	3.47	0.687	2.60	0.334	2.02	0.180	1.28	0.060			12.62	17.59
90	0.2005	8.60	6.20	6.03	2.53	3.91	0.861	2.92	0.416	2.27	0.224	1.44	0.074	6"		14.20	22.0
100	0.2228	9.56	7.69	6.70	3.09	4.34	1.05	3.25	0.509	2.52	0.272	1.60	0.090	1.11	0.036	15.78	26.9
125	0.2785	11.97	11.76	8.38	4.71	5.43	1.61	4.06	0.769	3.15	0.415	2.01	0.135	1.39	0.055	19.72	41.4
150	0.3342	14.36	16.70	10.05	6.69	6.51	2.24	4.87	1.08	3.78	0.580	2.41	0.190	1.67	0.077		
175	0.3899	16.75	22.3	11.73	8.97	7.60	3.00	5.68	1.44	4.41	0.774	2.81	0.253	1.94	0.102		
200	0.4456	19.14	28.8	13.42	11.68	8.68	3.87	6.49	1.85	5.04	0.985	3.21	0.323	2.22	0.130	8"	
225	0.5013	...	...	15.09	14.63	9.77	4.83	7.30	2.32	5.67	1.23	3.61	0.401	2.50	0.162	1.44	0.043
250	0.557	...	...	...	...	10.85	5.93	8.12	2.84	6.30	1.46	4.01	0.495	2.78	0.195	1.60	0.051
275	0.6127	...	...	...	...	11.94	7.14	8.93	3.40	6.93	1.79	4.41	0.583	3.05	0.234	1.76	0.061
300	0.6684	...	...	...	...	13.00	8.36	9.74	4.02	7.56	2.11	4.81	0.683	3.33	0.275	1.92	0.072
325	0.7241	...	...	...	...	14.12	9.89	10.53	4.09	8.19	2.47	5.21	0.797	3.61	0.320	2.08	0.083
350	0.7798			...	...	...	...	11.36	5.41	8.82	2.84	5.62	0.919	3.89	0.367	2.24	0.096
375	0.8355			...	...	...	...	12.17	6.18	9.45	3.25	6.02	1.05	4.16	0.416	2.40	0.108
400	0.8912			...	...	...	...	12.98	7.03	10.08	3.68	6.42	1.19	4.44	0.471	2.56	0.121
425	0.9469			...	...	...	...	13.80	7.89	10.71	4.12	6.82	1.33	4.72	0.529	2.73	0.136
450	1.003	10"		...	...	...	...	14.61	8.80	11.34	4.60	7.22	1.48	5.00	0.590	2.89	0.151
475	1.059	1.93	0.054			...	...	...	...	11.97	5.12	7.62	1.64	5.27	0.653	3.04	0.166
500	1.114	2.03	0.059			...	...	...	...	12.60	5.65	8.02	1.81	5.55	0.720	3.21	0.182
550	1.225	2.24	0.071			...	...	...	...	13.85	6.79	8.82	2.17	6.11	0.861	3.53	0.219
600	1.337	2.44	0.083			...	...	...	...	15.12	8.04	9.63	2.55	6.66	1.02	3.85	0.258
650	1.448	2.64	0.097			...	...	...	...	...	...	10.43	2.98	7.22	1.18	4.17	0.301

- Continued

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00242

ROA_03475

Flow of Water Through Schedule 40 Steel Pipe (Continued)

DISCHARGE		PRESSURE DROP PER 100 FEET AND VELOCITY IN SCHEDULE 40 PIPE FOR WATER AT 60 F															
Gallons per Minute	Cubic Ft. per Second	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)	Velocity (Feet per Sec.)	Press. Drop (PSI)
		10"		12"								5"		6"		8"	
700	1.560	2.85	0.112	2.01	0.047			...	...	...	...	11.23	3.43	7.78	1.35	4.49	0.343
750	1.671	3.05	0.127	2.15	0.054			...	...	...	...	12.03	3.92	8.33	1.55	4.81	0.392
800	1.782	3.25	0.143	2.29	0.061	14"		...	...	...	...	12.83	4.43	8.88	1.75	5.13	0.443
850	1.894	3.46	0.160	2.44	0.068	2.02	0.042	...	...	...	...	13.64	5.00	9.44	1.96	5.45	0.497
900	2.005	3.66	0.179	2.58	0.075	2.13	0.047	...	...	...	...	14.44	5.58	9.99	2.18	5.77	0.554
950	2.117	3.86	0.198	2.72	0.083	2.25	0.052			...	...	15.24	6.21	10.55	2.42	6.09	0.613
1000	2.228	4.07	0.218	2.87	0.091	2.37	0.057			...	...	16.04	6.84	11.10	2.68	6.41	0.675
1100	2.451	4.48	0.260	3.15	0.110	2.61	0.068	16"		...	...	17.65	8.23	12.22	3.22	7.05	0.807
1200	2.674	4.88	0.306	3.44	0.128	2.85	0.080	2.18	0.042	...	...	...	...	13.33	3.81	7.70	.948
1300	2.896	5.29	0.355	3.73	0.150	3.08	0.093	2.36	0.048	...	...	...	...	14.43	4.45	8.33	1.11
1400	3.119	5.70	0.409	4.01	0.171	3.32	0.107	2.54	0.055					15.55	5.13	8.98	1.28
1500	3.342	6.10	0.466	4.30	0.195	3.56	0.122	2.72	0.063					16.66	5.85	9.62	1.46
1600	3.565	6.51	0.527	4.59	0.219	3.79	0.138	2.90	0.071	18"				17.77	6.61	10.26	1.65
1800	4.010	7.32	0.663	5.16	0.276	4.27	0.172	3.27	0.088	2.58	0.050			19.99	8.37	11.54	2.08
2000	4.456	8.14	0.808	5.73	0.339	4.74	0.209	3.63	0.107	2.87	0.060			22.21	10.3	12.82	2.55
2500	5.570	10.17	1.24	7.17	0.515	5.93	0.321	4.54	0.163	3.59	0.091	20"				16.03	3.94
3000	6.684	12.20	1.76	8.60	0.731	7.11	0.451	5.45	0.232	4.30	0.129	3.46	0.075			19.24	5.59
3500	7.798	14.24	2.38	10.03	0.982	8.30	0.607	6.35	0.312	5.02	0.173	4.04	0.101	24"		22.44	7.56
4000	8.912	16.27	3.08	11.47	1.27	9.48	0.787	7.26	0.401	5.74	0.222	4.62	0.129	3.19	0.052	25.65	9.80
4500	10.03	18.31	3.87	12.90	1.60	10.67	0.990	8.17	0.503	6.46	0.280	5.20	0.162	3.59	0.065	28.87	12.2

- Continued -

calafish_00243

(Continued from facing page.)

		(10")		(12")		(14")		(16")		(18")		(20")		(24")			
5000	11.14	20.35	4.71	14.33	1.95	11.85	1.21	9.08	0.617	7.17	0.340	5.77	0.199	3.99	0.079	...	...
6000	13.37	24.41	6.74	17.20	2.77	14.23	1.71	10.89	0.877	8.61	0.483	6.93	0.280	4.79	0.111	...	...
7000	15.60	28.49	9.11	20.07	3.74	16.60	2.31	12.71	1.18	10.04	0.652	8.08	0.376	5.59	0.150	...	...
8000	17.82	...	...	22.93	4.84	18.96	2.99	14.52	1.51	11.47	0.839	9.23	0.488	6.38	0.192	...	...
9000	20.05	...	...	25.79	6.09	21.34	3.76	16.34	1.90	12.91	1.05	10.39	0.608	7.18	0.242	...	...
10,000	22.28	...	...	28.66	7.46	23.71	4.61	18.15	2.34	14.34	1.28	11.54	0.739	7.98	0.294	...	...
12,000	26.74	...	...	34.40	10.7	28.45	6.59	21.79	3.33	17.21	1.83	13.85	1.06	9.58	0.416	...	...
14,000	31.19	...	...	...	...	33.19	8.89	25.42	4.49	20.08	2.45	16.16	1.43	11.17	0.562	...	...
16,000	35.65	...	...	...	...	...	...	29.05	5.83	22.95	3.18	18.47	1.85	12.77	0.723	...	...
18,000	40.10	...	...	...	...	...	...	32.68	7.31	25.82	4.03	20.77	2.32	14.36	0.907	...	...
20,000	44.56	...	...	...	...	...	...	36.31	9.03	28.69	4.93	23.08	2.86	15.96	1.12	...	...

For pipe lengths other than 100 feet, the pressure drop is proportional to the length. Thus, for 50 feet of pipe, the pressure drop is approximately one-half the value given in the table . . . for 300 feet, three times the given value, etc.

Velocity is a function of the cross sectional flow area; thus, it is constant for a given flow rate and is independent of pipe length.

For calculations for pipe other than Schedule 40, see explanation on page 161.

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00244

ROA_03477

For lengths of pipe other than 100 feet, the pressure drop is proportional to the length. Thus, for 50 feet of pipe, the pressure drop is approximately one-half the value given in the table . . . for 300 feet, three times the given value, etc.

The pressure drop is also inversely proportional to the absolute pressure and directly proportional to the absolute temperature.

Therefore, to determine the pressure drop for inlet or average pressures other than 100 psi and at temperatures other than 60°F, multiply the values given in the table by the ratio:

$$\left(\frac{100 + 14.7}{P + 14.7}\right)\left(\frac{460 + t}{520}\right)$$

where:

"*P*" is the inlet or average gauge pressure in pounds per square inch, and,

"*t*" is the temperature in degrees Fahrenheit under consideration.

The cubic feet per minute of compressed air at any pressure is inversely proportional to the absolute pressure and directly proportional to the absolute temperature.

Flow of Air Through Schedule 40 Steel Pipe

FREE AIR q'm Cubic Feet Per Minute at 60°F and 14.7 psia	COMPRESSED AIR Cubic Feet Per Minute at 60°F and 100 psig	PRESSURE DROP OF AIR IN POUNDS PER SQUARE INCH PER 100 FEET OF SCHEDULE 40 PIPE FOR AIR AT 100 POUNDS PER SQUARE INCH GAUGE PRESSURE AND 60°F TEMPERATURE								
		1/8"	1/4"	3/8"	1/2"					
1	0.128	0.361	0.083	0.018						
2	0.256	1.31	0.285	0.064	0.020					
3	0.384	3.06	0.605	0.133	0.042	3/4"				
4	0.513	4.83	1.04	0.226	0.071					
5	0.641	7.45	1.58	0.343	0.108	0.027				
6	0.769	10.6	2.23	0.408	0.148	0.037	1"			
8	1.025	18.6	3.89	0.849	0.255	0.062	0.019			
10	1.282	28.7	5.96	1.26	0.356	0.094	0.029	1-1/4"		
15	1.922	...	13.0	2.73	0.834	0.201	0.062			
20	2.563	...	22.8	4.76	1.43	0.345	0.102	0.026	1-1/2"	
25	3.204	...	35.6	7.34	2.21	0.526	0.156	0.039	0.019	
30	3.845	...	...	10.5	3.15	0.748	0.219	0.055	0.026	
35	4.486	...	...	14.2	4.24	1.00	0.293	0.073	0.035	
40	5.126	...	...	18.4	5.49	1.30	0.379	0.095	0.044	
45	5.767	...	...	23.1	6.90	1.62	0.474	0.116	0.055	2"
50	6.408			28.5	8.49	1.99	0.578	0.149	0.067	0.019
60	7.690	2-1/2"		40.7	12.2	2.85	0.819	0.200	0.094	0.027
70	8.971			...	16.5	3.83	1.10	0.270	0.126	0.036
80	10.25	0.019		...	21.4	4.96	1.43	0.350	0.162	0.046
90	11.53	0.023		...	27.0	6.25	1.80	0.437	0.203	0.058

(Continued on facing page.)

calafish_00245

ROA_03478

To determine the cubic feet per minute of compressed air at any temperature and pressure other than standard conditions, multiply the value of cubic feet per minute of free air by the ratio:

$$\left(\frac{14.7}{14.7+P}\right)\left(\frac{460+t}{520}\right)$$

Calculations for Pipe Other than Schedule 40

To determine the velocity of water, or the pressure drop of water or air, through pipe other than Schedule 40, use the following formulas:

$$v_a = v_{40}\left(\frac{d_{40}}{d_a}\right)^2$$

$$\Delta P_a = \Delta P_{40}\left(\frac{d_{40}}{d_a}\right)^5$$

Subscript "*a*" refers to the Schedule of pipe through which velocity or pressure drop is desired.

Subscript "40" refers to the velocity or pressure drop through Schedule 40 pipe, as given in the tables on pages 156 through 163.

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

		(2-1/2")			(1/2")	(3/4")	(1")	(1-1/4")	(1-1/2")	(2")
100	12.82	0.029			33.2	7.69	2.21	0.534	0.247	0.070
125	16.02	0.044	3"		...	11.9	3.39	0.825	0.380	0.107
150	19.22	0.062	0.021		...	17.0	4.87	1.17	0.537	0.151
175	22.43	0.083	0.028		...	23.1	6.60	1.58	0.727	0.205
200	25.63	0.107	0.036	3-1/2"	...	30.0	8.54	2.05	0.937	0.264
225	28.84	0.134	0.045	0.022		37.9	10.8	2.59	1.19	0.331
250	32.04	0.164	0.055	0.027		...	13.3	3.18	1.45	0.404
275	35.24	0.191	0.066	0.032		...	16.0	3.83	1.75	0.484
300	38.45	0.232	0.078	0.037		...	19.0	4.56	2.07	0.573
325	41.65	0.270	0.090	0.043		...	22.3	5.32	2.42	0.673
350	44.87	0.313	0.104	0.050	4"	...	25.8	6.17	2.80	0.776
375	48.06	0.356	0.119	0.057	0.030	...	29.6	7.05	3.20	0.887
400	51.26	0.402	0.134	0.064	0.034	...	33.6	8.02	3.64	1.00
425	54.47	0.452	0.151	0.072	0.038	...	37.9	9.01	4.09	1.13
450	57.67	0.507	0.168	0.081	0.042	...	...	10.2	4.59	1.26
475	60.88	0.562	0.187	0.089	0.047		...	11.3	5.09	1.40
500	64.08	0.623	0.206	0.099	0.052		...	12.5	5.61	1.55
550	70.49	0.749	0.248	0.118	0.062		...	15.1	6.79	1.87
600	76.90	0.887	0.293	0.139	0.073		...	18.0	8.04	2.21
650	83.30	1.04	0.342	0.163	0.086	5"	...	21.1	9.43	2.60
700	89.71	1.19	0.395	0.188	0.099	0.032		24.3	10.9	3.00
750	96.12	1.36	0.451	0.214	0.113	0.036		27.9	12.6	3.44
800	102.5	1.55	0.513	0.244	0.127	0.041		31.8	14.2	3.90
850	108.9	1.74	0.576	0.274	0.144	0.046		35.9	16.0	4.40
900	115.3	1.95	0.642	0.305	0.160	0.051	6"	40.2	18.0	4.91
950	121.8	2.18	0.715	0.340	0.178	0.057	0.023	...	20.0	5.47
1,000	128.2	2.40	0.788	0.375	0.197	0.063	0.025	...	22.1	6.06
1,100	141.0	2.89	0.948	0.451	0.236	0.075	0.030	...	26.7	7.29
1,200	153.8	3.44	1.13	0.533	0.279	0.089	0.035	...	31.8	8.63
1,300	166.6	4.01	1.32	0.626	0.327	0.103	0.041	...	37.3	10.1

- Continued -

calafish_00246

ROA_03479

Flow of Air Through Schedule 40 Steel Pipe (Continued)

FREE AIR q'm	COMPRESSED AIR	PRESSURE DROP OF AIR IN POUNDS PER SQUARE INCH PER 100 FEET OF SCHEDULE 40 PIPE FOR AIR AT 100 POUNDS PER SQUARE INCH GAUGE PRESSURE AND 60°F TEMPERATURE								
Cubic Feet Per Minute at 60°F and 14.7 psia	Cubic Feet Per Minute at 60°F and 100 psig	2-1/2"	3"	3-1/2"	4"	5"	6"	8"	10"	12"
1,400	179.4	4.65	1.52	0.718	0.377	0.119	0.047			2"
1,500	192.2	5.31	1.74	0.824	0.431	0.136	0.054			11.8
1,600	205.1	6.04	1.97	0.932	0.490	0.154	0.061			13.5
1,800	230.7	7.65	2.50	1.18	0.616	0.193	0.075	8"		15.3
2,000	256.3	9.44	3.06	1.45	0.757	0.237	0.094	0.023		19.3
2,500	320.4	14.7	4.76	2.25	1.17	0.366	0.143	0.035	10"	23.9
3,000	384.5	21.1	6.82	3.20	1.67	0.524	0.204	0.051	0.016	37.3
3,500	448.6	28.8	9.23	4.33	2.26	0.709	0.276	0.068	0.022	
4,000	512.6	37.6	12.1	5.66	2.94	0.919	0.358	0.088	0.028	
4,500	576.7	47.6	15.3	7.16	3.69	1.16	0.450	0.111	0.035	12"
5,000	640.8	...	18.8	8.85	4.56	1.42	0.552	0.136	0.043	0.018
6,000	769.0	...	27.1	12.7	6.57	2.03	0.794	0.196	0.061	0.025
7,000	897.1	...	36.9	17.2	8.94	2.76	1.07	0.262	0.082	0.034
8,000	1026	...	...	22.5	11.7	3.59	1.39	0.339	0.107	0.044
9,000	1153	...	...	28.5	14.9	4.54	1.76	0.427	0.134	0.055
10,000	1282	...	...	35.2	18.4	5.60	2.16	0.526	0.164	0.067
11,000	1410	...	...	...	22.2	6.78	2.62	0.633	0.197	0.081
12,000	1538	...	...	...	26.4	8.07	3.09	0.753	0.234	0.096
13,000	1666	...	...	...	31.0	9.47	3.63	0.884	0.273	0.112
14,000	1794	...	...	...	36.0	11.0	4.21	1.02	0.316	0.129

- Continued -

calafish_00247

(Continued from facing page.)

						(5")	(6")	(8")	(10")	(12")
16,000	1922	...	...	...	...	12.6	4.84	1.17	0.364	0.148
16,000	2051	...	...	...	...	14.3	5.50	1.33	0.411	0.167
18,000	2307	...	...	...	...	18.2	6.96	1.68	0.520	0.213
20,000	2563	...	...	...	...	22.4	8.60	2.01	0.642	0.260
22,000	2820	...	...	...	...	27.1	10.4	2.50	0.771	0.314
24,000	3076	...	...	...	...	32.3	12.4	2.97	0.918	0.371
26,000	3332	...	...	...	...	37.9	14.5	3.49	1.12	0.435
28,000	3588	...	...	...	...	...	16.9	4.04	1.25	0.505
30,000	3845	...	...	...	...	...	19.3	4.64	1.42	0.520

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

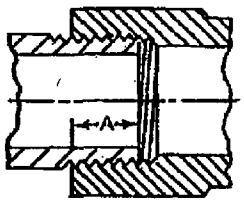
calafish_00248

ROA_03481

Section 8

Pipe Data

Pipe Engagement
Length of Thread on Pipe to Make a Tight Joint



Nominal Pipe Size (Inches)	Dimension A (Inches)	Nominal Pipe Size (Inches)	Dimension A (Inches)
1/8	1/4	1-1/2	11/16
1/4	3/8	2	3/4
3/8	3/8	2-1/2	15/16
1/2	1/2	3	1
3/4	9/16	4	1-1/8
1	11/16	5	1-1/4
1-1/4	11/16	6	1-5/16

Dimensions do not allow for variation in tapping or threading.

Drill Sizes for Pipe Taps

Nominal Pipe Size (Inches)	Tap Drill Size (Inches)	Nominal Pipe Size (Inches)	Tap Drill Size (Inches)
1/8	11/32	1-1/2	1-23/32
1/4	7/16	2	2-3/16
3/8	19/32	2-1/2	2-9/16
1/2	23/32	3	3-3/16
3/4	15/16	4	4-3/16
1	1-5/32	5	5-5/16
1-1/4	1-1/2	6	6-5/16

Pipe Data

Carbon and Alloy Steel—Stainless Steel

Identification, wall thickness and weights are extracted from ANSI B36.10 and B39.19. The notations STD, XS, and XXS indicate Standard, Extra Strong, and Double Extra Strong pipe respectively.

Transverse internal area values listed in "square feet" also represent volume in cubic feet per foot of pipe length.

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAM. (INCHES)	IDENTIFICATION			WALL THICK-NESS (t) (INCHES)	INSIDE DIAM-ETER (d) (INCHES)	AREA OF METAL (SQUARE INCHES)	TRANSVERSE INTERNAL AREA		WEIGHT PIPE (POUNDS PER FOOT)	WEIGHT WATER (POUNDS PER FOOT OF PIPE)
		Steel		Stainless Steel Sched. No.				(a) (Square Inches)	(A) (Square Feet)		
		Iron Pipe Size	Sched. No.								
1/8	0.405	...	...	10S	0.049	0.307	0.0548	0.0740	0.00051	0.19	0.032
		STD	40	40S	0.068	0.269	0.0720	0.0568	0.00040	0.24	0.025
		XS	80	80S	0.095	0.215	0.0925	0.0364	0.00025	0.31	0.016
1/4	0.540	...	...	10S	0.065	0.410	0.0970	0.1320	0.00091	0.33	0.057
		STD	40	40S	0.088	0.364	0.1250	0.1041	0.00072	0.42	0.045
		XS	80	80S	0.119	0.302	0.1574	0.0718	0.00050	0.54	0.031
3/8	0.675	...	...	10S	0.065	0.545	0.1246	0.2333	0.00162	0.42	0.101
		STD	40	40S	0.091	0.493	0.1670	0.1910	0.00133	0.57	0.083
		XS	80	80S	0.126	0.423	0.2173	0.1405	0.00098	0.74	0.061
1/2	0.840	...	...	5S	0.065	0.710	0.1583	0.3959	0.00275	0.54	0.172
		...	...	10S	0.083	0.674	0.1974	0.3568	0.00248	0.67	0.155
		STD	40	40S	0.109	0.622	0.2503	0.3040	0.00211	0.85	0.132
		XS	80	80S	0.147	0.546	0.3200	0.2340	0.00163	1.09	0.102
		...	160	...	0.187	0.466	0.3836	0.1706	0.00118	1.31	0.074
		XXS	...	...	0.294	0.252	0.5043	0.050	0.00035	1.71	0.022

calafish_00250

ROA_03483

3/4	1.050	...	...	5S	0.065	0.920	0.2011	0.6648	0.00462	0.69	0.288
		...	...	10S	0.083	0.884	0.2521	0.6138	0.00426	0.86	0.266
		STD	40	40S	0.113	0.824	0.3326	0.5330	0.00371	1.13	0.231
		XS	80	80S	0.154	0.742	0.4335	0.4330	0.00300	1.47	0.188
		...	160	...	0.219	0.612	0.5698	0.2961	0.00206	1.94	0.128
		XXS	...	...	0.308	0.434	0.7180	0.148	0.00103	2.44	0.064
1	1.315	...	...	5S	0.065	1.185	0.2563	1.1029	0.00766	0.87	0.478
		...	...	10S	0.109	1.097	0.4130	0.9452	0.00656	1.40	0.409
		STD	40	40S	0.133	1.049	0.4939	0.8640	0.00600	1.68	0.375
		XS	80	80S	0.179	0.957	0.6388	0.7190	0.00499	2.17	0.312
		...	160	...	0.250	0.815	0.8365	0.5217	0.00362	2.84	0.230
		XXS	...	...	0.358	0.599	1.0760	0.282	0.00196	3.66	0.122
1-1/4	1.660	...	...	5S	0.065	1.530	0.3257	1.839	0.01277	1.11	0.797
		...	...	10S	0.109	1.442	0.4717	1.633	0.01134	1.81	0.708
		STD	40	40S	0.140	1.380	0.6685	1.495	0.01040	2.27	0.649
		XS	80	80S	0.191	1.278	0.8815	1.283	0.00891	3.00	0.555
		...	160	...	0.250	1.160	1.1070	1.057	0.00734	3.76	0.458
		XXS	...	...	0.382	0.896	1.534	0.630	0.00438	5.21	0.273
1-1/2	1.900	...	...	5S	0.065	1.770	0.3747	2.461	0.01709	1.28	1.066
		...	...	10S	0.109	1.682	0.6133	2.222	0.01543	2.09	0.963
		STD	40	40S	0.145	1.610	0.7995	2.036	0.01414	2.72	0.882
		XS	80	80S	0.200	1.500	1.068	1.767	0.01225	3.63	0.765
		...	160	...	0.281	1.338	1.429	1.406	0.00976	4.86	0.608
		XXS	...	...	0.400	1.100	1.885	0.950	0.00660	6.41	0.42
2	2.375	...	...	5S	0.065	2.245	0.4717	3.958	0.02749	1.61	1.72
		...	...	10S	0.109	2.157	0.7760	3.654	0.02538	2.64	1.58
		STD	40	40S	0.154	2.067	1.075	3.355	0.02330	3.65	1.45
		XS	80	80S	0.218	1.939	1.477	2.953	0.02050	5.02	1.28
		...	160	...	0.344	1.687	2.190	2.241	0.01556	7.46	0.97
		XXS	...	...	0.436	1.503	2.656	1.774	0.01232	9.03	0.77

- Continued -

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00251

ROA_03484

Pipe Data

Carbon and Alloy Steel—Stainless Steel

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAM. (INCHES)	IDENTIFICATION			WALL THICK-NESS (t) (INCHES)	INSIDE DIAM-ETER (d) (INCHES)	AREA OF METAL (SQUARE INCHES)	TRANSVERSE INTERNAL AREA		WEIGHT PIPE (POUNDS PER FOOT)	WEIGHT WATER (POUNDS PER FOOT OF PIPE)
		Steel		Stainless Steel Sched. No.				(a) (Square Inches)	(A) (Square Feet)		
		Iron Pipe Size	Sched. No.								
2-1/2	2.875	...	...	5S	0.083	2.709	0.7280	5.764	0.04002	2.48	2.50
		...	...	10S	0.120	2.635	1.039	5.453	0.03787	3.53	2.36
		STD	40	40S	0.203	2.469	1.704	4.788	0.03322	5.79	2.07
		XS	80	80S	0.276	2.323	2.254	4.238	0.02942	7.66	1.87
		...	160	...	0.375	2.125	2.945	3.546	0.02463	10.01	1.54
		XXS	...	...	0.552	1.771	4.028	2.464	0.01710	13.69	1.07
3	3.500	...	...	5S	0.083	3.334	0.8910	8.730	0.06063	3.03	3.78
		...	...	10S	0.120	3.260	1.274	8.347	0.05796	4.33	3.62
		STD	40	40S	0.216	3.068	2.228	7.393	0.05130	7.58	3.20
		XS	80	80S	0.300	2.900	3.016	6.605	0.04587	10.25	2.86
		...	160	...	0.438	2.624	4.205	5.408	0.03755	14.32	2.35
		XXS	...	...	0.600	2.300	5.466	4.155	0.02885	18.58	1.80
3-1/2	4.000	...	...	5S	0.083	3.834	1.021	11.545	0.08017	3.48	5.00
		...	...	10S	0.120	3.760	1.463	11.104	0.07711	4.97	4.81
		STD	40	40S	0.226	3.548	2.680	9.886	0.06870	9.11	4.29
		XS	80	80S	0.318	3.364	3.678	8.888	0.06170	12.50	3.84
4	4.500	...	...	5S	0.083	4.334	1.152	14.75	0.10245	3.92	6.39
		...	...	10S	0.120	4.260	1.651	14.25	0.09898	5.61	8.18
		STD	40	40S	0.237	4.026	3.174	12.73	0.08840	10.79	5.50
		XS	80	80S	0.337	3.826	4.407	11.50	0.07986	14.98	4.98
		...	120	...	0.438	3.624	5.595	10.31	0.0716	19.00	4.47
		...	160	...	0.531	3.438	6.621	9.28	0.0645	22.51	4.02
		XXS	...	...	0.674	3.152	8.101	7.80	0.0542	27.54	3.38

calafish_00252

ROA_03485

5	5.563	...	...	5S	0.109	5.345	1.868	22.44	0.1558	6.36	9.72
		...	...	10S	0.134	5.295	2.285	22.02	0.1529	7.77	9.54
		STD	40	40S	0.258	5.047	4.300	20.01	0.1390	14.62	8.67
		XS	80	80S	0.375	4.813	6.112	18.19	0.1263	20.78	7.88
		...	120	...	0.500	4.563	7.953	16.35	0.1136	27.04	7.09
		...	160	...	0.625	4.313	9.696	14.61	0.1015	32.96	6.33
		XXS	...	...	0.750	4.063	11.340	12.97	0.0901	38.55	5.61
6	6.625	...	...	5S	0.109	6.407	2.231	32.24	0.2239	7.60	13.97
		...	...	10S	0.134	6.357	2.733	31.74	0.2204	9.29	13.75
		STD	40	40S	0.280	6.065	5.581	28.89	0.2006	18.97	12.51
		XS	80	80S	0.432	5.761	8.405	26.07	0.1810	28.57	11.29
		...	120	...	0.562	5.501	10.70	23.77	0.1650	36.39	10.30
		...	160	...	0.719	5.187	13.32	21.15	0.1469	45.35	9.16
		XXS	...	...	0.864	4.897	15.64	18.84	0.1308	53.16	8.16
8	8.625	...	...	5S	0.109	8.407	2.916	55.51	0.3855	9.93	24.06
		...	...	10S	0.148	8.329	3.941	54.48	0.3784	13.40	23.61
		...	20	...	0.250	8.125	6.57	51.85	0.3601	22.36	22.47
		...	30	...	0.277	8.071	7.26	51.16	0.3553	24.70	22.17
		STD	40	40S	0.322	7.981	8.40	50.03	0.3474	28.55	21.70
		...	60	...	0.406	7.813	10.48	47.94	0.3329	35.64	20.77
		XS	80	80S	0.500	7.625	12.76	45.66	0.3171	43.39	19.78
		...	100	...	0.594	7.437	14.96	43.46	0.3018	50.95	18.83
		...	120	...	0.719	7.187	17.84	40.59	0.2819	60.71	17.59
		...	140	...	0.812	7.001	19.93	38.50	0.2673	67.76	16.68
		XXS	...	...	0.875	6.875	21.30	37.12	0.2578	72.42	16.10
		...	160	...	0.906	6.813	21.97	36.46	0.2532	74.69	15.80
10 (Cont.)	10.750	...	...	5S	0.134	10.482	4.36	86.29	0.5992	15.19	37.39
		...	...	10S	0.165	10.420	5.49	85.28	0.5922	18.65	36.95
		...	20	...	0.250	10.250	8.24	82.52	0.5731	28.04	35.76
		...	30	...	0.307	10.136	10.07	80.69	0.5603	34.24	34.96
		STD	40	40S	0.365	10.020	11.90	78.86	0.5475	40.48	34.20

- Continued -

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00253

ROA_03486

Pipe Data

Carbon and Alloy Steel—Stainless Steel

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAM. (INCHES)	IDENTIFICATION			WALL THICK-NESS (t) (INCHES)	INSIDE DIAM-ETER (d) (INCHES)	AREA OF METAL (SQUARE INCHES)	TRANSVERSE INTERNAL AREA		WEIGHT PIPE (POUNDS PER FOOT)	WEIGHT WATER (POUNDS PER FOOT OF PIPE)
		Steel		Stainless Steel Sched. No.				(a) (Square Inches)	(A) (Square Feet)		
		Iron Pipe Size	Sched. No.								
10 (Cont.)	10.750	XS	60	80S	0.500	9.750	16.10	74.66	0.5185	54.74	32.35
		...	80	...	0.594	9.562	18.92	71.84	0.4989	64.43	31.13
		...	100	...	0.719	9.312	22.63	68.13	0.4732	77.03	29.53
		...	120	...	0.844	9.062	26.24	64.53	0.4481	89.29	27.96
		XXS	140	...	1.000	8.750	30.63	60.13	0.4176	104.13	26.06
		...	160	...	1.125	8.500	34.02	56.75	0.3941	115.64	24.59
12	12.75	...	...	5S	0.156	12.438	6.17	121.50	0.8438	20.98	52.65
		...	...	10S	0.180	12.390	7.11	120.57	0.8373	24.17	52.25
		...	20	...	0.250	12.250	9.82	117.86	0.8185	33.38	51.07
		...	30	...	0.330	12.090	12.87	114.80	0.7972	43.77	49.74
		STD	...	40S	0.375	12.000	14.58	113.10	0.7854	49.56	49.00
		...	40	...	0.406	11.938	15.77	111.93	0.7773	53.52	48.50
		XS	...	80S	0.500	11.750	19.24	108.43	0.7528	65.42	46.92
		...	60	...	0.562	11.626	21.52	106.16	0.7372	73.15	46.00
		...	80	...	0.688	11.374	26.03	101.64	0.7058	88.63	44.04
		...	100	...	0.844	11.062	31.53	96.14	0.6677	107.32	41.66
		XXS	120	...	1.000	10.750	36.91	90.76	0.6303	125.49	39.33
		...	140	...	1.125	10.500	41.08	86.59	0.6013	139.67	37.52
		...	160	...	1.312	10.126	47.14	80.53	0.5592	160.27	34.89
14 (Cont.)	14.00	...	...	5S	0.156	13.688	6.78	147.15	1.0219	23.07	63.77
		...	...	10S	0.188	13.624	8.16	145.78	1.0124	27.73	63.17
		...	10	...	0.250	13.500	10.80	143.14	0.9940	36.71	62.03
		...	20	...	0.312	13.376	13.42	140.52	0.9758	45.61	60.89
		STD	30	...	0.375	13.250	16.05	137.88	0.9575	54.57	59.75
		...	40	...	0.438	13.124	18.66	135.28	0.9394	63.44	58.64

calafish_00254

ROA_03487

14 (Cont.)	14.00	XS	...	...	0.500	13.000	21.21	132.73	0.9217	72.09	57.46
		...	60	...	0.594	12.812	24.98	128.96	0.8956	85.05	55.86
		...	80	...	0.750	12.500	31.22	122.72	0.8522	106.13	53.18
		...	100	...	0.938	12.124	38.45	115.49	0.8020	130.85	50.04
		...	120	...	1.094	11.812	44.32	109.62	0.7612	150.79	47.45
		...	140	...	1.250	11.500	50.07	103.87	0.7213	170.28	45.01
		...	160	...	1.406	11.188	55.63	98.31	0.6827	189.11	42.60
16	16.00	...	...	5S	0.165	15.670	8.21	192.85	1.3393	27.90	83.57
		...	...	10S	0.188	15.624	9.34	191.72	1.3314	31.75	83.08
		...	10	...	0.250	15.500	12.37	188.69	1.3103	42.05	81.74
		...	20	...	0.312	15.376	15.38	185.69	1.2895	52.27	80.50
		STD	30	...	0.375	15.250	18.41	182.65	1.2684	62.58	79.12
		XS	40	...	0.500	15.000	24.35	176.72	1.2272	82.77	76.58
		...	60	...	0.656	14.688	31.62	169.44	1.1766	107.50	73.42
		...	80	...	0.844	14.312	40.14	160.92	1.1175	136.61	69.73
		...	100	...	1.031	13.938	48.48	152.58	1.0596	164.82	66.12
		...	120	...	1.219	13.562	56.56	144.50	1.0035	192.43	62.62
		...	140	...	1.438	13.124	65.78	135.28	0.9394	223.64	58.64
		...	160	...	1.594	12.812	72.10	128.96	0.8956	245.25	55.83
18	18.00	...	...	5S	0.165	17.670	9.25	245.22	1.7029	31.43	106.26
		...	...	10S	0.188	17.624	10.52	243.95	1.6941	35.76	105.71
		...	10	...	0.250	17.500	13.94	240.53	1.6703	47.39	104.21
		...	20	...	0.312	17.376	17.34	237.13	1.6467	58.94	102.77
		STD	...	...	0.375	17.250	20.76	233.71	1.6230	70.59	101.18
		...	30	...	0.438	17.124	24.17	230.30	1.5990	82.15	99.84
		XS	...	...	0.500	17.000	27.49	226.98	1.5763	93.45	98.27
		...	40	...	0.562	16.876	30.79	223.68	1.5533	104.67	96.93
		...	60	...	0.750	16.500	40.64	213.83	1.4849	138.17	92.57
		...	80	...	0.938	16.124	50.23	204.24	1.4183	170.92	88.50
		...	100	...	1.156	15.688	61.17	193.30	1.3423	207.96	83.76
		...	120	...	1.375	15.250	71.81	182.66	1.2684	244.14	79.07
		...	140	...	1.562	14.876	80.66	173.80	1.2070	274.22	75.32
		...	160	...	1.781	14.438	90.75	163.72	1.1369	308.50	70.88

- Continued -

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00255

ROA_03488

Pipe Data

Carbon and Alloy Steel—Stainless Steel

NOMINAL PIPE SIZE (INCHES)	OUTSIDE DIAM. (INCHES)	IDENTIFICATION			WALL THICK-NESS (t) (INCHES)	INSIDE DIAM-ETER (d) (INCHES)	AREA OF METAL (SQUARE INCHES)	TRANSVERSE INTERNAL AREA		WEIGHT PIPE (POUNDS PER FOOT)	WEIGHT WATER (POUNDS PER FOOT OF PIPE)
		Steel		Stainless Steel Sched. No.				(a) (Square Inches)	(A) (Square Feet)		
		Iron Pipe Size	Sched. No.								
20	20.00	...	...	5S	0.188	19.624	11.70	302.46	2.1004	39.78	131.06
		...	...	10S	0.218	19.564	13.55	300.61	2.0876	46.06	130.27
		...	10	...	0.250	19.500	15.51	298.65	2.0740	52.73	129.42
		STD	20	...	0.375	19.250	23.12	290.04	2.0142	78.60	125.67
		XS	30	...	0.500	19.000	30.63	283.53	1.9690	104.13	122.87
		...	40	...	0.594	18.812	36.15	278.00	1.9305	123.11	120.46
		...	60	...	0.812	18.376	48.95	265.21	1.8417	166.40	114.92
		...	80	...	1.031	17.938	61.44	252.72	1.7550	208.87	109.51
		...	100	...	1.281	17.438	75.33	238.83	1.6586	256.10	103.39
		...	120	...	1.500	17.000	87.18	226.98	1.5762	296.37	98.35
		...	140	...	1.750	16.500	100.33	213.82	1.4849	341.09	92.66
		...	160	...	1.969	16.062	111.49	202.67	1.4074	379.17	87.74
22	22.00	...	...	5S	0.188	21.624	12.88	367.25	2.5503	43.80	159.14
		...	...	10S	0.218	21.564	14.92	365.21	2.5362	50.71	158.26
		...	10	...	0.250	21.500	17.08	363.05	2.5212	58.07	157.32
		STD	20	...	0.375	21.250	25.48	354.66	2.4629	86.61	153.68
		XS	30	...	0.500	21.000	33.77	346.36	2.4053	114.81	150.09
		...	60	...	0.875	20.250	58.07	322.06	2.2365	197.41	139.56
		...	80	...	1.125	19.75	73.78	306.35	2.1275	250.81	132.76
		...	100	...	1.375	19.25	89.09	291.04	2.0211	302.88	126.12
		...	120	...	1.625	18.75	104.02	276.12	1.9175	353.61	119.65
		...	140	...	1.875	18.25	118.55	261.59	1.8166	403.00	113.36
		...	160	...	2.125	17.75	132.68	247.45	1.7184	451.06	107.23

calafish_00256

24	24.00	...	...	5S	0.218	23.564	16.29	436.10	3.0285	55.37	188.98
		...	10	10S	0.250	23.500	18.65	433.74	3.0121	63.41	187.95
		STD	20	...	0.375	23.250	27.83	424.56	2.9483	94.62	183.95
		XS	...	...	0.500	23.000	36.91	415.48	2.8853	125.49	179.87
		...	30	...	0.562	22.876	41.39	411.00	2.8542	140.68	178.09
		...	40	...	0.688	22.624	50.31	402.07	2.7921	171.29	174.23
		...	60	...	0.969	22.062	70.04	382.35	2.6552	238.35	165.52
		...	80	...	1.219	21.562	87.17	365.22	2.5362	296.58	158.26
		...	100	...	1.531	20.938	108.07	344.32	2.3911	367.39	149.06
		...	120	...	1.812	20.376	126.31	326.08	2.2645	429.39	141.17
		...	140	...	2.062	19.876	142.11	310.28	2.1547	483.12	134.45
		...	160	...	2.344	19.312	159.41	292.98	2.0346	542.13	126.84
26	26.00	...	10	...	0.312	25.376	25.18	505.75	3.5122	85.60	219.16
		STD	...	...	0.375	25.250	30.19	500.74	3.4774	102.63	216.99
		XS	20	...	0.500	25.000	40.06	490.87	3.4088	136.17	212.71
28	28.00	...	10	...	0.312	27.376	27.14	588.61	4.0876	92.26	255.07
		STD	...	...	0.375	27.250	32.54	583.21	4.0501	110.64	252.73
		XS	20	...	0.500	27.000	43.20	572.56	3.9761	146.85	248.11
		...	30	...	0.625	26.750	53.75	562.00	3.9028	182.73	243.53
30	30.00	...	...	5S	0.250	29.500	23.37	683.49	4.7465	79.43	296.18
		...	10	10S	0.312	29.376	29.10	677.76	4.7067	98.93	293.70
		STD	...	...	0.375	29.250	34.90	671.96	4.6664	118.65	291.18
		XS	20	...	0.500	29.000	46.34	660.52	4.5869	157.53	286.22
		...	30	...	0.625	28.750	57.68	649.18	4.5082	196.08	281.31
32	32.00	...	10	...	0.312	31.376	31.06	773.19	5.3694	105.59	335.05
		STD	...	...	0.375	31.250	37.26	766.99	5.3263	126.66	332.36
		XS	20	...	0.500	31.000	49.48	754.77	5.2414	168.21	327.06
		...	30	...	0.625	30.750	61.60	742.64	5.1572	209.43	321.81
		...	40	...	0.688	30.624	67.68	736.57	5.1151	230.08	319.18

- Continued -

Extracted from Technical Paper No. 410, *Flow of Fluids*, with permission of Crane Co.

calafish_00257

ROA_03490

American Pipe Flange Dimensions
Diameter of Bolt Circle—Inches
Per ANSI B16.1, B16.5, and B16.24

Nominal Pipe Size (Inches)	ANSI Class* 125 (Cast Iron) or Class 150 (Steel)	ANSI Class† 250 (Cast Iron) or Class 300 (Steel)	ANSI Class 600	ANSI Class 900	ANSI Class 1500	ANSI Class 2500
1	3.12	3.50	3.50	4.00	4.00	4.25
1-1/4	3.50	3.88	3.88	4.38	4.38	5.12
1-1/2	3.88	4.50	4.50	4.88	4.88	5.75
2	4.75	5.00	5.00	6.50	6.50	6.75
2-1/2	5.50	5.88	5.88	7.50	7.50	7.75
3	6.00	6.62	6.62	7.50	8.00	9.00
4	7.50	7.88	8.50	9.25	9.50	10.75
5	8.50	9.25	10.50	11.00	11.50	12.75
6	9.50	10.62	11.50	12.50	12.50	14.50
8	11.75	13.00	13.75	15.50	15.50	17.25
10	14.25	15.25	17.00	18.50	19.00	21.75
12	17.00	17.75	19.25	21.00	22.50	24.38
14	18.75	20.25	20.75	22.00	25.00	...
16	21.25	22.50	23.75	24.25	27.75	...
18	22.75	24.75	25.75	27.00	30.50	...
20	25.00	27.00	28.50	29.50	32.75	...
24	29.50	32.00	33.00	35.50	39.00	...
30	36.00	39.25	...	...	...	...
36	42.75	46.00	...	...	...	...
42	49.50	52.75	...	...	...	...
48	56.00	60.75	...	...	...	...

*Sizes 1-inch through 12-inch also apply to ANSI Class 150 bronze flanges.
†Sizes 1-inch through 8-inch also apply to ANSI Class 300 bronze flanges.

American Pipe Flange Dimensions
Number of Stud Bolts and Diameter in Inches Per ANSI B16.1, B16.5, and B16.24

NOMINAL PIPE SIZE (INCHES)	ANSI CLASS* 125 (CAST IRON) OR CLASS 150 (STEEL)		ANSI CLASS† 250 (CAST IRON) OR CLASS 300 (STEEL)		ANSI CLASS 600		ANSI CLASS 900		ANSI CLASS 1500		ANSI CLASS 2500	
	No.	Dia.	No.	Dia.	No.	Dia.	No.	Dia.	No.	Dia.	No.	Dia.
1	4	0.50	4	0.62	4	0.62	4	0.88	4	0.88	4	0.88
1-1/4	4	0.50	4	0.62	4	0.62	4	0.88	4	0.88	4	1.00
1-1/2	4	0.50	4	0.75	4	0.75	4	1.00	4	1.00	4	1.12
2	4	0.62	8	0.62	8	0.62	8	0.88	8	0.88	8	1.00
2-1/2	4	0.62	8	0.75	8	0.75	8	1.00	8	1.00	8	1.12
3	4	0.62	8	0.75	8	0.75	8	0.88	8	1.12	8	1.25
4	8	0.62	8	0.75	8	0.75	8	1.12	8	1.25	8	1.50
5	8	0.75	8	0.75	8	1.00	8	1.25	8	1.50	8	1.75
6	8	0.75	12	0.75	12	1.00	12	1.12	12	1.38	8	2.00
8	8	0.75	12	0.88	12	1.12	12	1.38	12	1.62	12	2.00
10	12	0.88	16	1.00	16	1.25	16	1.38	12	1.88	12	2.50
12	12	0.88	16	1.12	20	1.25	20	1.38	16	2.00	12	2.75
14	12	1.00	20	1.12	20	1.38	20	1.50	16	2.25	...	...
16	16	1.00	20	1.25	20	1.50	20	1.62	16	2.50	...	...
18	16	1.12	24	1.25	20	1.62	20	1.88	16	2.75	...	...
20	20	1.12	24	1.25	24	1.62	20	2.00	16	3.00	...	...
24	20	1.25	24	1.50	24	1.88	20	2.50	16	3.50	...	...
30	28	1.25	28	1.75	...	...	...	...	...	...	...	...
36	32	1.50	32	2.00	...	...	...	...	...	...	...	...
42	36	1.50	36	2.00	...	...	...	...	...	...	...	...
48	44	1.50	40	2.00	...	...	...	...	...	...	...	...

*Sizes 1-inch through 12-inch also apply to ANSI Class 150 bronze flanges.
†Sizes 1-inch through 8-inch also apply to ANSI Class 300 bronze flanges.

calafish_00260

ROA_03492

American Pipe Flange Dimensions
Flange Diameter—Inches
Per ANSI B16.1, B16.5, and B16.24

Nominal Pipe Size	ANSI Class* 125 (Cast Iron) or Class 150 (Steel)	ANSI Class† 250 (Cast Iron) or Class 300 (Steel)	ANSI Class 600	ANSI Class 900	ANSI Class 1500	ANSI Class 2500
1	4.25	4.88	4.88	5.88	5.88	6.25
1-1/4	4.62	5.25	5.25	6.25	6.25	7.25
1-1/2	5.00	6.12	6.12	7.00	7.00	8.00
2	6.00	6.50	6.50	8.50	8.50	9.25
2-1/2	7.00	7.50	7.50	9.62	9.62	10.50
3	7.50	8.25	8.25	9.50	10.50	12.00
4	9.00	10.00	10.75	11.50	12.25	14.00
5	10.00	11.00	13.00	13.75	14.75	16.50
6	11.00	12.50	14.00	15.00	15.50	19.00
8	13.50	15.00	16.50	18.50	19.00	21.75
10	16.00	17.50	20.00	21.50	23.00	26.50
12	19.00	20.50	22.00	24.00	26.50	30.00
14	21.00	23.00	23.75	25.25	29.50	...
16	23.50	25.50	27.00	27.75	32.50	...
18	25.00	28.00	29.25	31.00	36.00	...
20	27.50	30.50	32.00	33.75	38.75	...
24	32.00	36.00	37.00	41.00	46.00	...
30	38.75	43.00	...	...	...	...
36	46.00	50.00	...	...	...	...
42	53.00	57.00	...	...	...	...
48	59.50	66.00	...	...	...	...

*Sizes 1-inch through 12-inch also apply to ANSI Class 150 bronze flanges.
†Sizes 1-inch through 8-inch also apply to ANSI Class 300 bronze flanges.

calafish_00261

ROA_03493

American Pipe Flange Dimensions

Flange Thickness—Inches

Per ANSI B16.1, B16.5, and B16.24

NOMINAL PIPE SIZE	ANSI CLASS 125 CAST IRON (FF) CLASS 150 STEEL (RF)	ANSI CLASS 150 STEEL (RTJ)	ANSI CLASS 150 BRONZE	ANSI CLASS 250 CAST IRON AND CLASS 300 STEEL		ANSI CLASS 300 BRONZE	ANSI CLASS 600		ANSI CLASS 900		ANSI CLASS 1500		ANSI CLASS 2500	
				RF	RTJ		RF	RTJ	RF	RTJ	RF	RTJ	RF	RTJ
1	0.44	0.69	0.38	0.69	0.94	0.59	0.94	0.94	1.38	1.38	1.38	1.38	1.62	1.62
1-1/4	0.50	0.75	0.41	0.75	1.00	0.62	1.06	1.06	1.38	1.38	1.38	1.38	1.75	1.81
1-1/2	0.56	0.81	0.44	0.81	1.06	0.69	1.12	1.12	1.50	1.50	1.50	1.50	2.00	2.06
2	0.62	0.88	0.50	0.88	1.19	0.75	1.25	1.31	1.75	1.81	1.75	1.81	2.25	2.31
2-1/2	0.69	0.94	0.56	1.00	1.31	0.81	1.38	1.44	1.88	1.94	1.88	1.94	2.50	2.62
3	0.75	1.00	0.62	1.12	1.44	0.91	1.50	1.56	1.75	1.81	2.12	2.19	2.88	3.00
4	0.94	1.19	0.69	1.25	1.56	1.06	1.75	1.81	2.00	2.06	2.38	2.44	3.25	3.44
5	0.94	1.19	0.75	1.38	1.69	1.12	2.00	2.06	2.25	2.31	3.12	3.19	3.88	4.12
6	1.00	1.25	0.81	1.44	1.75	1.19	2.12	2.19	2.44	2.50	3.50	3.62	4.50	4.75
8	1.12	1.38	0.94	1.62	1.94	1.38	2.44	2.50	2.75	2.81	3.88	4.06	5.25	5.56
10	1.19	1.44	1.00	1.88	2.19	...	2.75	2.81	3.00	3.06	4.50	4.69	6.75	7.19
12	1.25	1.50	1.06	2.00	2.31	...	2.88	2.94	3.38	3.44	5.12	5.44	7.50	7.94
14	1.38	1.62	...	2.12	2.44	...	3.00	3.06	3.62	3.81	5.50	5.88	...	...
16	1.44	1.69	...	2.25	2.56	...	3.25	3.31	3.75	3.94	6.00	6.44	...	...
18	1.56	1.81	...	2.38	2.69	...	3.50	3.56	4.25	4.50	6.62	7.06	...	...
20	1.69	1.94	...	2.50	2.88	...	3.75	3.88	4.50	4.75	7.25	7.69	...	...
24	1.88	2.12	...	2.75	3.19	...	4.25	4.44	5.75	6.12	8.25	8.81	...	...
30	2.12	...	...	3.00	...	...	...	...	...	...	...	...	...	...
36	2.38	...	...	3.38	...	...	...	...	...	...	...	...	...	...
42	2.62	...	...	3.69	...	...	...	...	...	...	...	...	...	...
48	2.75	...	...	4.00	...	...	...	...	...	...	...	...	...	...

calafish_00262

ROA_03494

DIN Standards

DIN Cast Steel Valve Ratings*

NOMINAL PRESSURE (BAR)	PERMISSIBLE WORKING PRESSURE (BAR) AT TEMP. SHOWN					
	−10°C to 120°C	200°C	250°C	300°C	350°C	400°C
16	16	14	13	11	10	8
25	25	22	20	17	16	13
40	40	35	32	28	24	21
64	64	50	45	40	36	32
100	100	80	70	60	56	50
160	160	130	112	96	90	80
250	250	200	175	150	140	125
320	320	250	225	192	180	160
400	400	320	280	240	225	200

* Hydrostatic test pressure: 1.5 times rating at 20°C.

DIN Cast Steel Flange Standard

Neandruck 16 (Nominal Pressure 16 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	6	90	16	60	4	M12	14
15	6	95	16	65	4	M12	14
20	6.5	105	18	75	4	M12	14
25	7	115	18	85	4	M12	14
32	7	140	18	100	4	M16	18
40	7.5	150	18	110	4	M16	18
50	8	165	20	125	4	M16	18
65	8	185	18	145	4	M16	18
80	8.5	200	20	160	8	M16	18
100	9.5	220	20	180	8	M16	18
125	10	250	22	210	8	M16	18
150	11	285	22	240	8	M20	23
175	12	315	24	270	8	M20	23
200	12	340	24	295	12	M20	23
250	14	405	26	355	12	M24	27
300	15	460	28	410	12	M24	27
350	16	520	30	470	16	M24	27
400	18	580	32	525	16	M27	30
500	21	715	36	650	20	M30	33
600	23	840	40	770	20	M33	36
700	24	910	42	840	24	M33	36
800	26	1025	42	950	24	M36	39
900	27	1125	44	1050	28	M36	39
1000	29	1255	46	1170	28	M39	42
1200	32	1485	52	1390	32	M45	48
1400	34	1685	58	1590	36	M45	48
1600	36	1930	64	1820	40	M52	56
1800	39	2130	68	2020	44	M52	56
2000	41	2345	70	2230	48	M56	62
2200	43	2555	74	2440	52	M56	62

All dimensions in mm.

calafish_00263

ROA_03495

DIN Cast Steel Flange Standard

Nenndruck 25 (Nominal Pressure 25 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	6	90	16	60	4	M12	14
15	6	95	16	65	4	M12	14
20	6.5	105	18	75	4	M12	14
25	7	115	18	85	4	M12	14
32	7	140	18	100	4	M16	18
40	7.5	150	18	110	4	M16	18
50	8	165	20	125	4	M16	18
65	8.5	185	22	145	8	M16	18
80	9	200	24	160	8	M16	18
100	10	235	24	190	8	M20	23
125	11	270	26	220	8	M24	27
150	12	300	28	250	8	M24	27
175	12	330	28	280	12	M24	27
200	12	360	30	310	12	M24	27
250	14	425	32	370	12	M27	30
300	15	485	34	430	16	M27	30
350	16	555	38	490	16	M30	33
400	18	620	40	550	16	M33	36
500	21	730	44	660	20	M33	36
600	23	845	46	770	20	M36	39
700	24	960	50	875	24	M39	42
800	26	1085	54	990	24	M45	48
900	27	1185	58	1090	28	M45	48
1000	29	1320	62	1210	28	M52	56
1200	32	1530	70	1420	32	M52	56
1400	34	1755	76	1640	36	M56	62
1600	37	1975	84	1860	40	M56	62
1800	40	2195	90	2070	44	M64	70
2000	43	2425	96	2300	48	M64	70

All dimensions in mm.

calafish_00264

ROA_03496

DIN Cast Steel Flange Standard

Nenndruck 40 (Nominal Pressure 40 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	6	90	16	60	4	M12	14
15	6	95	16	65	4	M12	14
20	6.5	105	18	75	4	M12	14
25	7	115	18	85	4	M12	14
32	7	140	18	100	4	M16	18
40	7.5	150	18	110	4	M16	18
50	8	165	20	125	4	M16	18
65	8.5	185	22	145	8	M16	18
80	9	200	24	160	8	M16	18
100	10	235	24	190	8	M20	23
125	11	270	26	220	8	M24	27
150	12	300	28	250	8	M24	27
175	13	350	32	295	12	M27	30
200	14	375	34	320	12	M27	30
250	16	450	38	385	12	M30	33
300	17	515	42	450	16	M30	33
350	19	580	46	510	16	M33	36
400	21	660	50	585	16	M36	39
450	21	685	50	610	20	M36	39
500	21	755	52	670	20	M39	42
600	24	890	60	795	20	M45	48
700	27	995	64	900	24	M45	48
800	30	1140	72	1030	24	M52	56
900	33	1250	76	1140	28	M52	56
1000	36	1360	80	1250	28	M52	56
1200	42	1575	88	1460	32	M56	62
1400	47	1795	98	1680	36	M56	62
1600	54	2025	108	1900	40	M64	70

All dimensions in mm.

calafish_00265

ROA_03497

DIN Cast Steel Flange Standard

Nenndruck 64 (Nominal Pressure 64 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	10	100	20	70	4	M12	14
15	10	105	20	75	4	M12	14
25	10	140	24	100	4	M16	18
32	12	155	24	110	4	M20	23
40	10	170	28	125	4	M20	22
50	10	180	26	135	4	M20	22
65	10	205	26	160	8	M20	22
80	11	215	28	170	8	M20	22
100	12	250	30	200	8	M24	26
125	13	295	34	240	8	M27	30
150	14	345	36	280	8	M30	33
175	15	375	40	310	12	M30	33
200	16	415	42	345	12	M33	36
250	19	470	46	400	12	M33	36
300	21	530	52	460	16	M33	36
350	23	600	56	525	16	M36	39
400	26	670	60	585	16	M39	42
500	31	800	68	705	20	M45	48
600	35	930	76	820	20	M52	56
700	40	1045	84	935	24	M52	56
800	45	1165	92	1050	24	M56	62
900	50	1285	98	1170	28	M56	62
1000	55	1415	108	1290	28	M64	70
1200	64	1665	126	1530	32	M72X6	78

All dimensions in mm.

calafish_00266

ROA_03498

DIN Cast Steel Flange Standard

Nenndruck 100 (Nominal Pressure 100 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	10	100	20	70	4	M12	14
15	10	105	20	75	4	M12	14
25	10	140	24	100	4	M16	18
32	12	155	24	110	4	M20	23
40	10	170	28	125	4	M20	22
50	10	195	30	145	4	M24	26
65	11	220	34	170	8	M24	26
80	12	230	36	180	8	M24	26
100	14	265	40	210	8	M27	30
125	16	315	40	250	8	M30	33
150	18	355	44	290	12	M30	33
175	20	385	48	320	12	M30	33
200	21	430	52	360	12	M33	36
250	25	505	60	430	12	M36	39
300	29	585	68	500	16	M39	42
350	32	655	74	560	16	M45	48
400	36	715	78	620	16	M45	48
500	44	870	94	760	20	M52	56
600	51	990	104	875	20	M56	62
700	59	1145	120	1020	24	M64	70

All dimensions in mm.

DIN Cast Steel Flange Standard

Nenndruck 160 (Nominal Pressure 160 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	10	100	20	70	4	M12	14
15	10	105	20	75	4	M12	14
25	10	140	24	100	4	M16	18
40	10	170	28	125	4	M20	22
50	10	195	30	145	4	M24	26
65	11	220	34	170	8	M24	26
80	12	230	36	180	8	M24	26
100	14	265	40	210	8	M27	30
125	16	315	44	250	8	M30	33
150	18	355	50	290	12	M30	33
175	19	390	54	320	12	M33	36
200	21	430	60	360	12	M33	36
250	31	516	68	430	12	M39	42
300	36	585	78	500	16	M39	42

All dimensions in mm.

DIN Cast Steel Flange Standard

Nenndruck 250 (Nominal Pressure 250 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	10	125	24	85	4	M16	18
15	10	130	26	90	4	M16	18
25	11	150	28	105	4	M20	22
40	13	185	34	135	4	M24	26
50	13	200	38	150	8	M24	26
65	14	230	42	180	8	M24	26
80	16	265	48	200	8	M27	30
100	19	300	54	235	8	M30	33
125	22	340	60	275	12	M30	33
150	25	390	68	320	12	M33	36
175	29	430	74	355	12	M36	39
200	32	485	82	400	12	M39	42
250	38	585	100	490	16	M45	48
300	47	690	120	590	16	M48	52

All dimensions in mm.

calafish_00268

ROA_03500

DIN Cast Steel Flange Standard

Nenndruck 320 (Nominal Pressure 320 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	11	125	24	85	4	M16	18
15	11	130	26	90	4	M16	18
25	11	160	34	115	4	M20	22
40	14	195	38	145	4	M24	26
50	15	210	42	160	8	M24	26
65	18	255	51	200	8	M27	30
80	19	275	55	220	8	M27	30
100	24	335	65	265	8	M33	36
125	27	380	75	310	12	M33	36
150	32	425	84	350	12	M36	39
175	36	485	95	400	12	M39	42
200	38	525	103	440	16	M39	42
250	49	640	125	540	16	M48	52

All dimensions in mm.

DIN Cast Steel Flange Standard

Nenndruck 400 (Nominal Pressure 400 Bar)

NOMINAL BORE	PIPE THICK-NESS	FLANGE			BOLTING		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	11	125	28	85	4	M16	18
15	11	145	30	100	4	M20	23
25	12	180	38	130	4	M24	26
40	15	220	48	165	4	M27	30
50	18	235	52	180	8	M27	30
65	22	290	64	225	8	M30	33
80	25	305	68	240	8	M30	33
100	30	370	80	295	8	M36	39
125	36	415	92	340	12	M36	39
150	41	475	105	390	12	M39	42
175	47	545	120	450	12	M45	48
200	53	585	130	490	16	M45	48

All dimensions in mm.

calafish_00269

Section 9

General Reference Tables

Circumferences and Areas of Circles

Diameter (In.)	Circum. (In.)	Area (Sq In.)	Diameter (In.)	Circum. (In.)	Area (Sq In.)
1/32	.0982	.00077	13/16	2.5525	.51849
1/16	.1963	.00307	27/32	2.6507	.55914
3/32	.2945	.00690	7/8	2.7489	.60132
1/8	.3927	.01228	29/32	2.8471	.64504
5/32	.4909	.01916	15/16	2.9452	.69029
3/16	.5890	.02761	31/32	3.0434	.73708
7/32	.6872	.03758	1	3.1416	.7854
1/4	.7854	.04909	1-1/16	3.3379	.8866
9/32	.8836	.06213	1-1/8	3.5343	.9940
5/16	.9817	.07670	1-3/16	3.7306	1.1075
11/32	1.0799	.09281	1-1/4	3.9270	1.2272
3/8	1.1781	.11045	1-5/16	4.1233	1.3530
13/32	1.2763	.12962	1-3/8	4.3197	1.4849
7/16	1.3744	.15033	1-7/16	4.5160	1.6230
15/32	1.4726	.17257	1-1/2	4.7124	1.7671
1/2	1.5708	.19635	1-9/16	4.9087	1.9175
17/32	1.6690	.22166	1-5/8	5.1051	2.0739
9/16	1.7671	.24850	1-11/16	5.3014	2.2365
19/32	1.8653	.27688	1-3/4	5.4978	2.4053
5/8	1.9635	.30680	1-13/16	5.6941	2.5802
21/32	2.0617	.33824	1-7/8	5.8905	2.7612
11/16	2.1598	.37122	1-15/16	6.0868	2.9483
23/32	2.2580	.40574	2	6.2832	3.1416
3/4	2.3562	.44179	2-1/16	6.4795	3.3410
25/32	2.4544	.47937	2-1/8	6.6759	3.5466

- Continued -

Circumferences and Areas of Circles (Continued)

Diameter (In.)	Circum. (In.)	Area (Sq In.)	Diameter (In.)	Circum. (In.)	Area (Sq In.)
2-3/16	6.8722	3.7583	5	15.7080	19.635
2-1/4	7.0686	3.9761	5-1/16	15.9043	20.129
2-5/16	7.2649	4.2000	5-1/8	16.1007	20.629
2-3/8	7.4613	4.4301	5-3/16	16.2970	21.135
2-7/16	7.6576	4.6664	5-1/4	16.4934	21.648
2-1/2	7.8540	4.9087	5-5/16	16.6897	22.166
2-9/16	8.0503	5.1572	5-3/8	16.8861	22.691
2-5/8	8.2467	5.4119	5-7/16	17.0824	23.221
2-11/16	8.4430	5.6727	5-1/2	17.2788	23.758
2-3/4	8.6394	5.9396	5-9/16	17.4751	24.301
2-13/16	8.8357	6.2126	5-5/8	17.6715	24.850
2-7/8	9.0321	6.4918	5-11/16	17.8678	25.406
2-15/16	9.2284	6.7771	5-3/4	18.0642	25.967
3	9.4248	7.0686	5-13/16	18.2605	26.535
3-1/16	9.6211	7.3662	5-7/8	18.4569	27.109
3-1/8	9.8175	7.6699	5-15/16	18.6532	27.688
3-3/16	10.0138	7.9798	6	18.8496	28.274
3-1/4	10.2102	8.2958	6-1/8	19.2423	29.465
3-5/16	10.4065	8.6179	6-1/4	19.6350	30.680
3-3/8	10.6029	8.9462	6-3/8	20.0277	31.919
3-7/16	10.7992	9.2806	6-1/2	20.4204	33.183
3-1/2	10.9956	9.6211	6-5/8	20.8131	34.472
3-9/16	11.1919	9.9678	6-3/4	21.2058	35.785
3-5/8	11.3883	10.321	6-7/8	21.5984	37.122
3-11/16	11.5846	10.680	7	21.9911	38.485
3-3/4	11.7810	11.045	7-1/8	22.3838	39.871
3-13/16	11.9773	11.416	7-1/4	22.7765	41.282
3-7/8	12.1737	11.793	7-3/8	23.1692	42.718
3-15/16	12.3700	12.177	7-1/2	23.5619	44.179
4	12.5664	12.566	7-5/8	23.9456	45.664
4-1/16	12.7627	12.962	7-3/4	24.3473	47.173
4-1/8	12.9591	13.364	7-7/8	24.7400	48.707
4-3/16	13.1554	13.772	8	25.1327	50.265
4-1/4	13.3518	14.186	8-1/8	25.5254	51.848
4-5/16	13.5481	14.607	8-1/4	25.9181	53.456
4-3/8	13.7445	15.033	8-3/8	26.3108	55.088
4-7/16	13.9408	15.466	8-1/2	26.7035	56.745
4-1/2	14.1372	15.904	8-5/8	27.0962	58.426
4-9/16	14.3335	16.349	8-3/4	27.4889	60.132
4-5/8	14.5299	16.800	8-7/8	27.8816	61.862
4-11/16	14.7262	17.257	9	28.2743	63.617
4-3/4	14.9226	17.721	9-1/8	28.6670	65.397
4-13/16	15.1189	18.190	9-1/4	29.0597	67.201
4-7/8	15.3153	18.665	9-3/8	29.4524	69.029
4-15/16	15.5116	19.147	9-1/2	29.8451	70.882

- Continued -

Circumferences and Areas of Circles (Continued)

Diameter (In.)	Circum. (In.)	Area (Sq In.)	Diameter (In.)	Circum. (In.)	Area (Sq In.)
9-5/8	30.2378	72.760	20-1/2	64.4026	330.06
9-3/4	30.6305	74.662	20-3/4	65.1880	338.16
9-7/8	31.0232	76.589	21	65.9734	346.36
10	31.4159	78.540	21-1/4	66.7588	354.66
10-1/4	32.2013	82.516	21-1/2	67.5442	363.05
10-1/2	32.9867	86.590	21-3/4	68.3296	371.54
10-3/4	33.7721	90.763	22	69.1150	380.13
11	34.5575	95.033	22-1/4	69.9004	388.82
11-1/4	35.3429	99.402	22-1/2	70.6858	397.61
11-1/2	36.1283	103.87	22-3/4	71.4712	406.49
11-3/4	36.9137	108.43	23	72.2566	415.48
12	37.6991	113.10	23-1/4	73.0420	424.56
12-1/4	38.4845	117.86	23-1/2	73.8274	433.74
12-1/2	39.2699	122.72	23-3/4	74.6128	443.01
12-3/4	40.0553	127.68	24	75.3982	452.39
13	40.8407	132.73	24-1/4	76.1836	461.86
13-1/4	41.6261	137.89	24-1/2	76.9690	471.44
13-1/2	42.4115	143.14	24-3/4	77.7544	481.11
13-3/4	43.1969	148.49	25	78.5398	490.87
14	43.9823	153.94	25-1/4	79.3252	500.74
14-1/4	44.7677	159.48	25-1/2	80.1106	510.71
14-1/2	45.5531	165.13	25-3/4	80.8960	520.77
14-3/4	46.3385	170.87	26	81.6814	530.93
15	47.1239	176.71	26-1/4	82.4668	541.19
15-1/4	47.9093	182.65	26-1/2	83.2522	551.55
15-1/2	48.6947	188.69	26-3/4	84.0376	562.00
15-3/4	49.4801	194.83	27	84.8230	572.56
16	50.2655	201.06	27-1/4	85.6084	583.21
16-1/4	51.0509	207.39	27-1/2	86.3938	593.96
16-1/2	51.8363	213.82	27-3/4	87.1792	604.81
16-3/4	52.6217	220.35	28	87.9646	615.75
17	53.4071	226.98	28-1/4	88.7500	626.80
17-1/4	54.1925	233.71	28-1/2	89.5354	637.94
17-1/2	54.9779	240.53	28-3/4	90.3208	649.18
17-3/4	55.7633	247.45	29	91.1062	660.52
18	56.5487	254.47	29-1/4	91.8916	671.96
18-1/4	57.3341	261.59	29-1/2	92.6770	683.49
18-1/2	58.1195	268.80	29-3/4	93.4624	695.13
18-3/4	58.9049	276.12	30	94.2478	706.86
19	59.6903	283.53	30-1/4	95.0332	718.69
19-1/4	60.4757	291.04	30-1/2	95.8186	730.62
19-1/2	61.2611	298.65	30-3/4	96.6040	742.64
19-3/4	62.0465	306.35	31	97.3894	754.77
20	62.8319	314.16	31-1/4	98.1748	766.99
20-1/4	63.6173	322.06	31-1/2	98.9602	779.31

- Continued -

Circumferences and Areas of Circles (Continued)

Diameter (In.)	Circum. (In.)	Area (Sq In.)	Diameter (In.)	Circum. (In.)	Area (Sq In.)
31-3/4	99.7456	791.73	41-3/4	131.161	1369.0
32	100.531	804.25	42	131.947	1385.4
32-1/4	101.316	816.86	42-1/4	132.732	1402.0
32-1/2	102.102	829.58	42-1/2	133.518	1418.6
32-3/4	102.887	842.39	42-3/4	134.303	1435.4
33	103.673	855.30	43	135.088	1452.2
33-1/4	104.458	868.31	43-1/4	135.874	1469.1
33-1/2	105.243	881.41	43-/12	136.659	1486.2
33-3/4	106.029	894.62	43-3/4	137.445	1503.3
34	106.814	907.92	44	138.230	1520.5
34-1/4	107.600	921.32	44-1/4	139.015	1537.9
34-1/2	108.385	934.82	44-1/2	139.801	1555.3
34-3/4	109.170	948.42	44-3/4	140.586	1572.8
35	109.956	962.11	45	141.372	1590.4
35-/14	110.741	975.91	45-1/4	142.157	1608.2
35-1/2	111.527	989.80	45-1/2	142.942	1626.0
35-3/4	112.312	1003.8	45-3/4	143.728	1643.9
36	113.097	1017.9	46	144.513	1661.9
36-1/4	113.883	1032.1	46-1/4	145.299	1680.0
36-1/2	114.668	1046.3	46-1/2	146.084	1698.2
36-3/4	115.454	1060.7	46-3/4	146.869	1716.5
37	116.239	1075.2	47	147.655	1734.9
37-1/4	117.024	1089.8	47-1/4	148.440	1753.5
37-1/2	117.810	1104.5	47-1/2	149.226	1772.1
37-3/4	118.596	1119.2	47-3/4	150.011	1790.8
38	119.381	1134.1	48	150.796	1809.6
38-1/4	120.166	1149.1	48-1/4	151.582	1828.5
38-1/2	120.951	1164.2	48-1/2	152.367.	1847.5
38-3/4	121.737	1179.3	48-3/4	153.153	1866.5
39	122.522	1194.6	49	153.938	1885.7
39-1/4	123.308	1210.0	49-1/4	154.723	1905.0
39-1/2	124.093	1225.4	49-1/2	155.509	1924.4
39-3/4	124.878	1241.0	49-3/4	156.294	1943.9
40	125.664	1256.6	50	157.080	1963.5
40-1/4	126.449	1272.4			
40-1/2	127.235	1288.2			
40-3/4	128.020	1304.2			
41	128.805	1320.3			
41-1/4	129.591	1338.4			
41-1/2	130.376	1352.7			

calafish_00273

Common Logarithms

No.	0	1	2	3	4	5	6	7	8	9
0	...	0000	3010	4771	6021	6990	7782	8451	9031	9542
1	0000	0414	0792	1139	1461	1761	2041	2304	2553	2788
2	3010	3222	3424	3617	3802	3979	4150	4314	4472	4624
3	4771	4914	5051	5185	5315	5441	5563	5682	5798	5911
4	6021	6128	6232	6335	6435	6532	6628	6721	6812	6902
5	6990	7076	7160	7243	7324	7404	7482	7559	7634	7709
6	7782	7853	7924	7993	8062	8129	8195	8261	8325	8388
7	8451	8513	8573	8633	8692	8751	8808	8865	8921	8976
8	9031	9085	9138	9191	9243	9294	9345	9395	9445	9494
9	9542	9590	9638	9685	9731	9777	9823	9868	9912	9956
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899
39	5911	5922	5933	5944	5955	5966	5977	5988	6999	6010
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325
43	6335	6345	6355	6365	6375	6385	6395	6405	6416	6425
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618

- Continued -

Common Logarithms (Continued)

No.	0	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7816
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586

- Continued -

Common Logarithms (Continued)

No.	0	1	2	3	4	5	6	7	8	9
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996
100	0000	0004	0009	0013	0017	0022	0026	0030	0035	0039

Metric Prefixes and Symbols

Multiplication Factor	Prefix	Symbol
1 000 000 000 000 000 000 = 10^{18}	exa	E
1 000 000 000 000 000 = 10^{15}	peta	P
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto*	h
10 = 10^{1}	deka*	da
0.1 = 10^{-1}	deci*	d
0.01 = 10^{-2}	centi*	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

*Avoid usage, if possible.

Greek Alphabet

Caps	Lower Case	Greek Name	Caps	Lower Case	Greek Name	Caps	Lower Case	Greek Name
A	α	Alpha	I	ι	Iota	P	ρ	Rho
B	β	Beta	K	κ	Kappa	Σ	σ	Sigma
Γ	γ	Gamma	Λ	λ	Lambda	T	τ	Tau
Δ	δ	Delta	M	μ	Mu	Y	υ	Upsilon
E	ε	Epsilon	N	ν	Nu	Φ	φ φ	Phi
Z	ζ	Zeta	Ξ	ξ	Xi	X	χ	Chi
H	η	Eta	O	ο	Omicron	Ψ	ψ	Psi
Θ	θ	Theta	Π	π	Pi	Ω	ω	Omega

calafish_00276

ROA_03508

Natural Trigonometric Functions

Deg	Function	0.0°	0.1°	0.2°	0.3°	0.4°	0.5°	0.6°	0.7°	0.8°	0.9°
	sin	0.0000	0.0017	0.0035	0.0052	0.0070	0.0087	0.0105	0.0122	0.0140	0.0157
0	cos	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999	0.9999	0.9999
	tan	0.0000	0.0017	0.0035	0.0052	0.0070	0.0087	0.0105	0.0122	0.0140	0.0157
	sin	0.0175	0.0192	0.0209	0.0227	0.0244	0.0262	0.0279	0.0297	0.0314	0.0332
1	cos	0.9998	0.9998	0.9998	0.9997	0.9997	0.9997	0.9996	0.9996	0.9995	0.9995
	tan	0.0175	0.0192	0.0209	0.0227	0.0244	0.0262	0.0279	0.0297	0.0314	0.0332
	sin	0.0349	0.0366	0.0384	0.0401	0.0419	0.0436	0.0454	0.0471	0.0488	0.0506
2	cos	0.9994	0.9993	0.9993	0.9992	0.9991	0.9990	0.9990	0.9989	0.9988	0.9987
	tan	0.0349	0.0367	0.0384	0.0402	0.0419	0.0437	0.0454	0.0472	0.0489	0.0507
	sin	0.0523	0.0541	0.0558	0.0576	0.0593	0.0600	0.0628	0.0645	0.0663	0.0680
3	cos	0.9986	0.9985	0.9984	0.9983	0.9982	0.9981	0.9980	0.9979	0.9978	0.9977
	tan	0.0524	0.0542	0.0559	0.0577	0.0594	0.0612	0.0629	0.0647	0.0664	0.0682
	sin	0.0698	0.0715	0.0732	0.0750	0.0767	0.0785	0.0802	0.0819	0.0837	0.0854
4	cos	0.9976	0.9974	0.9973	0.9972	0.9971	0.9969	0.9968	0.9966	0.9965	0.9963
	tan	0.0699	0.0717	0.0734	0.0752	0.0769	0.0787	0.0805	0.0822	0.0840	0.0857
	sin	0.0872	0.0889	0.0906	0.0924	0.0941	0.0958	0.0976	0.0993	0.1011	0.1028
5	cos	0.9962	0.9960	0.9959	0.9957	0.9956	0.9954	0.9952	0.9951	0.9949	0.9947
	tan	0.0875	0.0892	0.0910	0.0928	0.0945	0.0963	0.0981	0.0998	0.1016	0.1033
	sin	0.1045	0.1063	0.1080	0.1097	0.1115	0.1132	0.1149	0.1167	0.1184	0.1201
6	cos	0.9945	0.9943	0.9942	0.9940	0.9938	0.9936	0.9934	0.9932	0.9930	0.9928
	tan	0.1051	0.1069	0.1086	0.1104	0.1122	0.1139	0.1157	0.1175	0.1192	0.1210
	sin	0.1219	0.1236	0.1253	0.1271	0.1288	0.1305	0.1323	0.1340	0.1357	0.1374
7	cos	0.9925	0.9923	0.9921	0.9919	0.9917	0.9914	0.9912	0.9910	0.9907	0.9905
	tan	0.1228	0.1246	0.1263	0.1281	0.1299	0.1317	0.1334	0.1352	0.1370	0.1388

calafish_00277

ROA_03509

	sin	0.1392	0.1409	0.1426	0.1444	0.1461	0.1478	0.1495	0.1513	0.1530	0.1547
8	cos	0.9903	0.9900	0.9898	0.9895	0.9893	0.9890	0.9888	0.9885	0.9882	0.9880
	tan	0.1405	0.1423	0.1441	0.1459	0.1477	0.1495	0.1512	0.1530	0.1548	0.1566
	sin	0.1564	0.1582	0.1599	0.1616	0.1633	0.1650	0.1668	0.1685	0.1702	0.1719
9	cos	0.9877	0.9874	0.9871	0.9869	0.9866	0.9863	0.9860	0.9857	0.9854	0.9851
	tan	0.1584	0.1602	0.1620	0.1638	0.1655	0.1673	0.1691	0.1709	0.1727	0.1745
	sin	0.1736	0.1754	0.1771	0.1788	0.1805	0.1822	0.1840	0.1857	0.1874	0.1891
10	cos	0.9848	0.9845	0.9842	0.9839	0.9836	0.9833	0.9829	0.9826	0.9823	0.9820
	tan	0.1763	0.1781	0.1799	0.1817	0.1835	0.1853	0.1871	0.1890	0.1908	0.1926
	sin	0.1908	0.1925	0.1942	0.1959	0.1977	0.1994	0.2011	0.2028	0.2045	0.2062
11	cos	0.9816	0.9813	0.9810	0.9806	0.9803	0.9799	0.9796	0.9792	0.9789	0.9785
	tan	0.1944	0.1962	0.1980	0.1998	0.2016	0.2035	0.2053	0.2071	0.2089	0.2107
	sin	0.2079	0.2096	0.2113	0.2130	0.2147	0.2164	0.2181	0.2198	0.2215	0.2232
12	cos	0.9781	0.9778	0.9774	0.9770	0.9767	0.9763	0.9759	0.9755	0.9751	0.9748
	tan	0.2126	0.2144	0.2162	0.2180	0.2199	0.2217	0.2235	0.2254	0.2272	0.2290
	sin	0.2250	0.2267	0.2284	0.2300	0.2318	0.2334	0.2351	0.2368	0.2385	0.2402
13	cos	0.9744	0.9740	0.9736	0.9732	0.9728	0.9724	0.9720	0.9715	0.9711	0.9707
	tan	0.2309	0.2327	0.2345	0.2364	0.2382	0.2401	0.2419	0.2438	0.2456	0.2475
	sin	0.2419	0.2436	0.2453	0.2470	0.2487	0.2504	0.2521	0.2538	0.2554	0.2571
14	cos	0.9703	0.9699	0.9694	0.9690	0.9686	0.9681	0.9677	0.9673	0.9668	0.9664
	tan	0.2493	.02512	0.2530	0.2549	0.2568	0.2586	0.2605	0.2623	0.2642	0.2661
	sin	0.2588	0.2605	0.2622	0.2639	0.2658	0.2672	0.2689	0.2706	0.2723	0.2740
15	cos	0.9659	0.9655	0.9650	0.9646	0.9641	0.9636	0.9632	0.9627	0.9622	0.9617
	tan	0.2679	0.2698	0.2717	0.2736	0.2754	0.2773	0.2792	0.2811	0.2830	0.2849

- Continued -

calafish_00278

Natural Trigonometric Functions (Continued)

Deg	Function	0.0°	0.1°	0.2°	0.3°	0.4°	0.5°	0.6°	0.7°	0.8°	0.9°
	sin	0.2756	0.2773	0.2790	0.2807	0.2823	0 2840	0.2857	0.2874	0.2890	0.2907
16	cos	0.9613	0.9608	0.9603	0.9598	0.9593	0.9588	0.9583	0.9578	0.9573	0.9568
	tan	0.2867	0.2886	0.2905	0.2924	0.2943	0.2962	0.2981	0.3000	0.3019	0.3038
	sin	0.2924	0.2940	0.2957	0.2974	0.2990	0.3007	0.3024	0.3040	0.3057	0.3074
17	cos	0.9563	0.9558	0.9553	0.9548	0.9542	0.9537	0.9532	0.9527	0.9521	0.9516
	tan	0.3057	0.3076	0.3096	0.3115	0.3134	0.3153	0.3172	0.3191	0.3211	0.3230
	sin	0.3090	0.3107	0.3123	0.3140	0.3156	0.3173	0.3190	0.3206	0.3223	0.3239
18	cos	0.9511	0.9505	0.9500	0.9494	0.9489	0.9483	0.9478	0.9472	0.9466	0.9461
	tan	0.3249	0.3268	0.3288	0.3307	0.3327	0.3346	0.3365	0.3385	0.3404	0.3424
	sin	0.3256	0.3272	0.3289	0.3305	0.3322	0.3338	0.3355	0.3371	0.3387	0.3404
19	cos	0.9455	0.9449	0.9444	0.9438	0.9432	0.9426	0.9421	0.9415	0.9409	0.9403
	tan	0.3443	0.3463	0.3482	0.3502	0.3522	0.3541	0.3561	0.3581	0.3600	0.3620
	sin	0.3420	0.3437	0.3453	0.3469	0.3486	0.3502	0.3518	0.3535	0.3551	0.3567
20	cos	0.9397	0.9391	0.9385	0.9379	0.9373	0.9367	0.9361	0.9354	0.9348	0.9342
	tan	0.3640	0.3659	0.3679	0.3699	0.3719	0.3739	0.3759	0.3779	0.3799	0.3819
	sin	0.3584	0.3600	0.3616	0.3633	0.3649	0.3665	0.3681	0.3697	0.3714	0.3730
21	cos	0.9336	0.9330	0.9323	0.9317	0.9311	0.9304	0.9298	0.9291	0.9285	0.9278
	tan	0.3839	0.3859	0.3879	0.3899	0.3919	0.3939	0.3959	0.3979	0.4000	0.4020
	sin	0.3746	0.3762	0.3778	0.3795	0.3811	0.3827	0.3843	0.3859	0.3875	0.3891
22	cos	0.9272	0.9265	0.9259	0.9252	0.9245	0.9239	0.9232	0.9225	0.9219	0.9212
	tan	0.4040	0.4061	0.4081	0.4101	0.4122	0.4142	0.4163	0.4183	0.4204	0.4224
	sin	0.3907	0.3923	0.3939	0.3955	0.3971	0.3987	0.4003	0.4019	0.4035	0.4051
23	cos	0.9205	0.9198	0.9191	0.9184	0.9178	0.9171	0.9164	0.9157	0.9150	0.9143
	tan	0.4245	0.4265	0.4286	0.4307	0.4327	0.4348	0.4369	0.4390	0.4411	0.4431

calafish_00279

ROA_03511

24	sin	0.4067	0.4083	0.4099	0.4115	0.4131	0.4147	0.4163	0.4179	0.4195	0.4210
	cos	0.9135	0.9128	0.9121	0.9114	0.9107	0.9100	0.9092	0.9085	0.9078	0.9070
	tan	0.4452	0.4473	0.4494	0.4515	0.4536	0.4557	0.4578	0.4599	0.4621	0.4642
25	sin	0.4226	0.4242	0.4258	0.4274	0.4289	0.4305	0.4321	0.4337	0.4352	0.4368
	cos	0.9063	0.9056	0.9048	0.9041	0.9033	0.9026	0.9018	0.9011	0.9003	0.8996
	tan	0.4663	0.4684	0.4706	0.4727	0.4748	0.4770	0.4791	0.4813	0.4834	0.4856
26	sin	0.4384	0.4399	0.4415	0.4431	0.4446	0.4462	0.4478	0.4493	0.4509	0.4524
	cos	0.8988	0.8980	0.8973	0.8965	0.8957	0.8949	0.8942	0.8934	0.8926	0.8918
	tan	0.4877	0.4899	0.4921	0.4942	0.4964	0.4986	0.5008	0.5029	0.5051	0.5073
27	sin	0.4540	0.4555	0.4571	0.4586	0.4602	0.4617	0.4633	0.4648	0.4664	0.4679
	cos	0.8910	0.8902	0.8894	0.8886	0.8878	0.8870	0.8862	0.8854	0.8846	0.8838
	tan	0.5095	0.5117	0.5139	0.5161	0.5184	0.5206	0.5228	0.5250	0.5272	0.5295
28	sin	0.4695	0.4710	0.4726	0.4741	0.4756	0.4772	0.4787	0.4802	0.4818	0.4833
	cos	0.8829	0.8821	0.8813	0.8805	0.8796	0.8788	0.8780	0.8771	0.8763	0.8755
	tan	0.5317	0.5340	0.5362	0.5384	0.5407	0.5430	0.5452	0.5475	0.5498	0.5520
29	sin	0.4848	0.4863	0.4879	0.4894	0.4909	0.4924	0.4939	0.4955	0.4970	0.4985
	cos	0.8746	0.8738	0.8729	0.8721	0.8712	0.8704	0.8695	0.8686	0.8678	0.8669
	tan	0.5543	0.5566	0.5589	0.5612	0.5635	0.5658	0.5681	0.5704	0.5727	0.5750
30	sin	0.5000	0.5015	0.5030	0.5045	0.5060	0.5075	0.5090	0.5105	0.5120	0.5135
	cos	0.8660	0.8652	0.8643	0.8634	0.8625	0.8616	0.8607	0.8599	0.8590	0.8581
	tan	0.5774	0.5797	0.5820	0.5844	0.5867	0.5890	0.5914	0.5938	0.5961	0.5985
31	sin	0.5150	0.5165	0.5180	0.5195	0.5210	0.5225	0.5240	0.5255	0.5270	0.5284
	cos	0.8572	0.8563	0.8554	0.8545	0.8536	0.8526	0.8517	0.8508	0.8499	0.8490
	tan	0.6009	0.6032	0.6056	0.6080	0.6104	0.6128	0.6152	0.6176	0.6200	0.6224

- Continued -

calafish_00280

ROA_03512

Natural Trigonometric Functions (Continued)

Deg	Function	0.0°	0.1°	0.2°	0.3°	0.4°	0.5°	0.6°	0.7°	0.8°	0.9°
32	sin	0.5299	0.5314	0.5329	0.5344	0.5358	0.5373	0.5388	0.5402	0.5417	0.5432
	cos	0.8480	0.8471	0.8462	0.8453	0.8443	0.8434	0.8425	0.8415	0.8406	0.8396
	tan	0.6249	0.6273	0.6297	0.6322	0.6346	0.6371	0.6395	0.6420	0.6445	0.6469
33	sin	0.5446	0.5461	0.5476	0.5490	0.5505	0.5519	0.5534	0.5548	0.5563	0.5577
	cos	0.8387	0.8377	0.8368	0.8358	0.8348	0.8339	0.8329	0.8320	0.8310	0.8300
	tan	0.6494	0.6519	0.6544	0.6569	0.6594	0.6619	0.6644	0.6669	0.6694	0.6720
34	sin	0.5592	0.5606	0.5621	0.5635	0.5650	0.5664	0.5678	0.5693	0.5707	0.5721
	cos	0.8290	0.8281	0.8271	0.8261	0.8251	0.8241	0.8231	0.8221	0.8211	0.8202
	tan	0.6745	0.6771	0.6796	0.6822	0.6847	0.6873	0.6899	0.6924	0.6950	0.6976
35	sin	0.5736	0.5750	0.5764	0.5779	0.5793	0.5807	0.5821	0.5835	0.5850	0.5864
	cos	0.8192	0.8181	0.8171	0.8161	0.8151	0.8141	0.8131	0.8121	0.8111	0.8100
	tan	0.7002	0.7028	0.7054	0.7080	0.7107	0.7133	0.7159	0.7186	0.7212	0.7239
36	sin	0.5878	0.5892	0.5906	0.5920	0.5934	0.5948	0.5962	0.5976	0.5990	0.6004
	cos	0.8090	0.8080	0.8070	0.8059	0.8049	0.8039	0.8028	0.8018	0.8007	0.7997
	tan	0.7265	0.7292	0.7319	0.7346	0.7373	0.7400	0.7427	0.7454	0.7481	0.7508
37	sin	0.6018	0.6032	0.6046	0.6060	0.6074	0.6088	0.6101	0.6115	0.6129	0.6143
	cos	0.7986	0.7976	0.7965	0.7955	0.7944	0.7934	0.7923	0.7912	0.7902	0.7891
	tan	0.7536	0.7563	0.7590	0.7618	0.7646	0.7673	0.7701	0.7729	0.7757	0.7785
38	sin	0.6157	0.6170	0.6184	0.6198	0.6211	0.6225	0.6239	0.6252	0.6266	0.6280
	cos	0.7880	0.7869	0.7859	0.7848	0.7837	0.7826	0.7815	0.7804	0.7793	0.7782
	tan	0.7813	0.7841	0.7869	0.7898	0.7926	0.7954	0.7983	0.8012	0.8040	0.8069
39	sin	0.6293	0.6307	0.6320	0.6334	0.6347	0.6361	0.6374	0.6388	0.6401	0.6414
	cos	0.7771	0.7760	0.7749	0.7738	0.7727	0.7716	0.7705	0.7694	0.7683	0.7672
	tan	0.8098	0.8127	0.8156	0.8185	0.8214	0.8243	0.8273	0.8302	0.8332	0.8361

calafish_00281

40	sin	0.6428	0.6441	0.6455	0.6468	0.6481	0.6494	0.6508	0.6521	0.6534	0.6547
	cos	0.7660	0.7649	0.7638	0.7627	0.7616	0.7604	0.7593	0.7581	0.7570	0.7559
	tan	0.8391	0.8421	0.8451	0.8481	0.8511	0.8541	0.8571	0.8601	0.8632	0.8662
41	sin	0.6561	0.6574	0.6587	0.6600	0.6613	0.6626	0.6639	0.6652	0.6665	0.6678
	cos	0.7547	0.7536	0.7524	0.7513	0.7501	0.7490	0.7478	0.7466	0.7455	0.7443
	tan	0.8693	0.8724	0.8754	0.8785	0.8816	0.8847	0.8878	0.8910	0.8941	0.8972
42	sin	0.6691	0.6704	0.6717	0.6730	0.6743	0.6756	0.6769	0.6782	0.6794	0.6807
	cos	0.7431	0.7420	0.7408	0.7396	0.7385	0.7373	0.7361	0.7349	0.7337	0.7325
	tan	0.9004	0.9036	0.9067	0.9099	0.9131	0.9163	0.9195	0.9228	0.9260	0.9293
43	sin	0.6820	0.6833	0.6845	0.6858	0.6871	0.6884	0.6896	0.6909	0.6921	0.6934
	cos	0.7314	0.7302	0.7290	0.7278	0.7266	0.7254	0.7242	0.7230	0.7218	0.7206
	tan	0.9325	0.9358	0.9391	0.9424	0.9457	0.9490	0.9523	0.9556	0.9590	0.9623
44	sin	0.6947	0.6959	0.6972	0.6984	0.6997	0.7009	0.7022	0.7034	0.7046	0.7059
	cos	0.7193	0.7181	0.7169	0.7157	0.7145	0.7133	0.7120	0.7108	0.7096	0.7083
	tan	0.9657	0.9691	0.9725	0.9759	0.9793	0.9827	0.9861	0.9896	0.9930	0.9965
45	sin	0.7071	0.7083	0.7096	0.7108	0.7120	0.7133	0.7145	0.7157	0.7169	0.7181
	cos	0.7071	0.7059	0.7046	0.7034	0.7022	0.7009	0.6997	0.6984	0.6972	0.6959
	tan	1.0000	1.0035	1.0070	1.0105	1.0141	1.0176	1.0212	1.0247	1.0283	1.0319
46	sin	0.7193	0.7206	0.7218	0.7230	0.7242	0.7254	0.7266	0.7278	0.7290	0.7302
	cos	0.6947	0.6934	0.6921	0.6909	0.6896	0.6884	0.6871	0.6858	0.6845	0.6833
	tan	1.0355	1.0392	1.0428	1.0464	1.0501	1.0538	1.0575	1.0612	1.0649	1.0686
47	sin	0.7314	0.7325	0.7337	0.7349	0.7361	0.7373	0.7385	0.7396	0.7408	0.7420
	cos	0.6820	0.6807	0.6794	0.6782	0.6769	0.6756	0.6743	0.6730	0.6717	0.6704
	tan	1.0724	1.0761	1.0799	1.0837	1.0875	1.0913	1.0951	1.0990	1.1028	1.1067

- Continued -

calafish_00282

ROA_03514

Natural Trigonometric Functions (Continued)

Deg	Function	0.0°	0.1°	0.2°	0.3°	0.4°	0.5°	0.6°	0.7°	0.8°	0.9°
	sin	0.7431	0.7443	0.7455	0.7466	0.7478	0.7490	0.7501	0.7513	0.7524	0.7536
48	cos	0.6691	0.6678	0.6665	0.6652	0.6639	0.6626	0.6613	0.6600	0.6587	0.6574
	tan	1.1106	1.1145	1.1184	1.1224	1.1263	1.1303	1.1343	1.1383	1.1423	1.1463
	sin	0.7547	0.7559	0.7570	0.7581	0.7593	0.7604	0.7615	0.7627	0.7638	0.7649
49	cos	0.6561	0.6547	0.6534	0.6521	0.6508	0.6494	0.6481	0.6468	0.6455	0.6441
	tan	1.1504	1.1544	1.1585	1.1626	1.1667	1.1708	1.1750	1.1792	1.1833	1.1875
	sin	0.7660	0.7672	0.7683	0.7694	0.7705	0.7716	0.7727	0.7738	0.7749	0.7760
50	cos	0.6428	0.6414	0.6401	0.6388	0.6374	0.6361	0.6347	0.6334	0.6320	0.6307
	tan	1.1918	1.1960	1.2002	1.2045	1.2088	1.2131	1.2174	1.2218	1.2261	1.2305
	sin	0.7771	0.7782	0.7793	0.7804	0.7815	0.7826	0.7837	0.7848	0.7859	0.7869
51	cos	0.6293	0.6280	0.6266	0.6252	0.6239	0.6225	0.6211	0.6198	0.6184	0.6170
	tan	1.2349	1.2393	1.2437	1.2482	1.2527	1.2572	1.2617	1.2662	1.2708	1.2753
	sin	0.7880	0.7891	0.7902	0.7912	0.7923	0.7934	0.7944	0.7955	0.7965	0.7976
52	cos	0.6157	0.6143	0.6129	0.6115	0.6101	0.6088	0.6074	0.6060	0.6046	0.6032
	tan	1.2799	1.2846	1.2892	1.2938	1.2985	1.3032	1.3079	1.3127	1.3175	1.3222
	sin	0.7986	0.7997	0.8007	0.8018	0.8028	0.8039	0.8049	0.8059	0.8070	0.8080
53	cos	0.6018	0.6004	0.5990	0.5976	0.5962	0.5948	0.5934	0.5920	0.5906	0.5892
	tan	1.3270	1.3319	1.3367	1.3416	1.3465	1.3514	1.3564	1.3613	1.3663	1.3713
	sin	0.8090	0.8100	0.8111	0.8121	0.8131	0.8141	0.8151	0.8161	0.8171	0.8181
54	cos	0.5878	0.5864	0.5850	0.5835	0.5821	0.5807	0.5793	0.5779	0.5764	0.5750
	tan	1.3764	1.3814	1.3865	1.3916	1.3968	1.4019	1.4071	1.4124	1.4176	1.4229
	sin	0.8192	0.8202	0.8211	0.8221	0.8231	0.8241	0.8251	0.8261	0.8271	0.8281
55	cos	0.5736	0.5721	0.5707	0.5693	0.5678	0.5664	0.5650	0.5635	0.5621	0.5606
	tan	1.4281	1.4335	1.4388	1.4442	1.4496	1.4550	1.4605	1.4659	1.4715	1.4770

calafish_00283

	sin	0.8290	0.8300	0.8310	0.8320	0.8329	0.8339	0.8348	0.8358	0.8368	0.8377
56	cos	0.5592	0.5577	0.5563	0.5548	0.5534	0.5519	0.5505	0.5490	0.5476	0.5461
	tan	1.4826	1.4882	1.4938	1.4994	1.5051	1.5108	1.5166	1.5224	1.5282	1.5340
	sin	0.8387	0.8396	0.8406	0.8415	0.8425	0.8434	0.8443	0.8453	0.8462	0.8471
57	cos	0.5446	0.5432	0.5417	0.5402	0.5388	0.5373	0.5358	0.5344	0.5329	0.5314
	tan	1.5399	1.5458	1.5517	1.5577	1.5637	1.5697	1.5757	1.5818	1.5880	1.5941
	sin	0.8480	0.8490	0.8499	0.8508	0.8517	0.8526	0.8536	0.8545	0.8554	0.8563
58	cos	0.5299	0.5284	0.5270	0.5255	0.5240	0.5225	0.5210	0.5195	0.5180	0.5165
	tan	1.6003	1.6066	1.6128	1.6191	1.6255	1.6319	1.6383	1.6447	1.6512	1.6577
	sin	0.8572	0.8581	0.8590	0.8599	0.8607	0.8616	0.8625	0.8634	0.8643	0.8652
59	cos	0.5150	0.5135	0.5120	0.5105	0.5090	0.5075	0.5060	0.5045	0.5030	0.5015
	tan	1.6643	1.6709	1.6775	1.6842	1.6909	1.6977	1.7045	1.7113	1.7182	1.7251
	sin	0.8660	0.8669	0.8678	0.8686	0.8695	0.8704	0.8712	0.8721	0.8729	0.8738
60	cos	0.5000	0.4985	0.4970	0.4955	0.4939	0.4924	0.4909	0.4894	0.4879	0.4863
	tan	1.7321	1.7391	1.7461	1.7532	1.7603	1.7675	1.7747	1.7820	1.7893	1.7966
	sin	0.8746	0.8755	0.8763	0.8771	0.8780	0.8788	0.8796	0.8805	0.8813	0.8821
61	cos	0.4848	0.4833	0.4818	0.4802	0.4787	0.4772	0.4756	0.4741	0.4726	0.4710
	tan	1.8040	1.8115	1.8190	1.8265	1.8341	1.8418	1.8495	1.8572	1.8650	1.8728
	sin	0.8829	0.8838	0.8846	0.8854	0.8862	0.8870	0.8878	0.8886	0.8894	0.8902
62	cos	0.4695	0.4679	0.4664	0.4648	0.4633	0.4617	0.4602	0.4586	0.4571	0.4555
	tan	1.8807	1.8887	1.8967	1.9047	1.9128	1.9210	1.9292	1.9375	1.9458	1.9542
	sin	0.8910	0.8918	0.8926	0.8934	0.8942	0.8949	0.8957	0.8965	0.8973	0.8980
63	cos	0.4540	0.4524	0.4509	0.4493	0.4478	0.4462	0.4446	0.4431	0.4415	0.4399
	tan	1.9626	1.9711	1.9797	1.9883	1.9970	2.0057	2.0145	2.0233	2.0323	2.0413

- Continued -

calafish_00284

ROA_03516

Natural Trigonometric Functions (Continued)

Deg	Function	0.0°	0.1°	0.2°	0.3°	0.4°	0.5°	0.6°	0.7°	0.8°	0.9°
64	sin	0.8988	0.8996	0.9003	0.9011	0.9018	0.9026	0.9033	0.9041	0.9048	0.9056
	cos	0.4384	0.4368	0.4352	0.4337	0.4321	0.4305	0.4289	0.4274	0.4258	0.4242
	tan	2.0503	2.0594	2.0686	2.0778	2.0872	2.0965	2.1060	2.1155	2.1251	2.1348
65	sin	0.9063	0.9070	0.9078	0.9085	0.9092	0.9100	0.9107	0.9114	0.9121	0.9128
	cos	0.4226	0.4210	0.4195	0.4179	0.4163	0.4147	0.4131	0.4115	0.4099	0.4083
	tan	2.1445	2.1543	2.1642	2.1742	2.1842	2.1943	2.2045	2.2148	2.2251	2.2355
66	sin	0.9135	0.9143	0.9150	0.9157	0.9164	0.9171	0.9178	0.9184	0.9191	0.9198
	cos	0.4067	0.4051	0.4035	0.4019	0.4003	0.3987	0.3971	0.3955	0.3939	0.3923
	tan	2.2460	2.2566	2.2673	2.2781	2.2889	2.2998	2.3109	2.3220	2.3332	2.3445
67	sin	0.9205	0.9212	0.9219	0.9225	0.9232	0.9239	0.9245	0.9252	0.9259	0.9265
	cos	0.3907	0.3891	0.3875	0.3859	0.3843	0.3827	0.3811	0.3795	0.3778	0.3762
	tan	2.3559	2.3673	2.3789	2.3906	2.4023	2.4142	2.4262	2.4383	2.4504	2.4627
68	sin	0.9272	0.9278	0.9285	0.9291	0.9298	0.9304	0.9311	0.9317	0.9323	0.9330
	cos	0.3746	0.3730	0.3714	0.3697	0.3681	0.3665	0.3649	0.3633	0.3616	0.3600
	tan	2.4751	2.4876	2.5002	2.5129	2.5257	2.5386	2.5517	2.5649	2.5782	2.5916
69	sin	0.9336	0.9342	0.9348	0.9354	0.9361	0.9367	0.9373	0.9379	0.9385	0.9391
	cos	0.3584	0.3567	0.3551	0.3535	0.3518	0.3502	0.3486	0.3469	0.3453	0.3437
	tan	2.6051	2.6187	2.6325	2.6464	2.6605	2.6746	2.6889	2.7034	2.7179	2.7326
70	sin	0.9397	0.9403	0.9409	0.9415	0.9421	0.9426	0.9432	0.9438	0.9444	0.9449
	cos	0.3420	0.3404	0.3387	0.3371	0.3355	0.3338	0.3322	0.3305	0.3289	0.3272
	tan	2.7475	2.7625	2.7776	2.7929	2.8083	2.8239	2.8397	2.8556	2.8716	2.8878
71	sin	0.9455	0.9461	0.9466	0.9472	0.9478	0.9483	0.9489	0.9494	0.9500	0.9505
	cos	0.3256	0.3239	0.3223	0.3206	0.3190	0.3173	0.3156	0.3140	0.3123	0.3107
	tan	2.9042	2.9208	2.9375	2.9544	2.9714	2.9887	3.0061	3.0237	3.0415	3.0595

calafish_00285

72	sin	0.9511	0.9516	0.9521	0.9527	0.9532	0.9537	0.9542	0.9548	0.9553	0.9558
	cos	0.3090	0.3074	0.3057	0.3040	0.3024	0.3007	0.2990	0.2974	0.2957	0.2940
	tan	3.0777	3.0981	3.1146	3.1334	3.1524	3.1716	3.1910	3.2106	3.2305	3.2506
73	sin	0.9563	0.9568	0.9573	0.9578	0.9583	0.9588	0.9593	0.9598	0.9603	0.9608
	cos	0.2924	0.2907	0.2890	0.2874	0.2857	0.2840	0.2823	0.2807	0.2790	0.2773
	tan	3.2709	3.2914	3.3122	3.3332	3.3544	3.3759	3.3977	3.4197	3.4420	3.4646
74	sin	0.9813	0.9617	0.9622	0.9627	0.9632	0.9636	0.9641	0.9646	0.9650	0.9655
	cos	0.2756	0.2740	0.2723	0.2706	0.2689	0.2672	0.2656	0.2639	0.2622	0.2605
	tan	3.4874	3.5105	3.5339	.35576	3.5816	3.6059	3.6305	3.6554	3.6806	3.7062
75	sin	0.9659	0.9664	0.9668	0.9673	0.9677	0.9681	0.9686	0.9690	0.9694	0.9699
	cos	0.2588	0.2571	0.2554	0.2538	0.2521	0.2504	0.2487	0.2470	0.2453	0.2436
	tan	3.7321	3.7583	3.7848	3.8118	3.8391	3.8667	3.8947	3.9232	3.9520	3.9812
76	sin	0.9703	0.9707	0.9711	0.9715	0.9720	0.9724	0.9728	0.9732	0.9736	0.9740
	cos	0.2419	0.2402	0.2385	0.2368	0.2351	0.2334	0.2317	0.2300	0.2284	0.2267
	tan	4.0108	4.0408	4.0713	4.1022	4.1335	4.1653	4.1976	4.2303	4.2635	4.2972
77	sin	0.9774	0.9748	0.9751	0.9755	0.9759	0.9763	0.9767	0.9770	0.9774	0.9778
	cos	0.2250	0.2232	0.2215	0.2198	0.2181	0.2164	0.2147	0.2130	0.2113	0.2096
	tan	4.3315	4.3662	4.4015	4.4374	4.4737	4.5107	4.5483	4.5864	4.6252	4.6646
78	sin	0.9781	0.9785	0.9789	0.9792	0.9796	0.9799	0.9803	0.9806	0.9810	0.9813
	cos	0.2079	0.2062	0.2045	0.2028	0.2011	0.1994	0.1977	0.1959	0.1942	0.1925
	tan	4.7046	4.7453	4.7867	4.8288	4.8716	4.9152	4.9594	5.0045	5.0504	5.0970
79	sin	0.9816	0.9820	0.9823	0.9826	0.9829	0.9833	0.9836	0.9839	0.9842	0.9845
	cos	0.1908	0.1891	0.1874	0.1857	0.1840	0.1822	0.1805	0.1788	0.1771	0.1754
	tan	5.1446	5.1929	5.2422	5.2924	5.3435	5.3955	5.4486	5.5026	5.5578	5.6140

- Continued -

calafish_00286

Natural Trigonometric Functions (Continued)

Deg	Function	0.0°	0.1°	0.2°	0.3°	0.4°	0.5°	0.6°	0.7°	0.8°	0.9°
	sin	0.9848	0.9851	0.9854	0.9857	0.9860	0.9863	0.9866	0.9869	0.9871	0.9874
80	cos	0.1736	0.1719	0.1702	0.1685	0.1668	0.1650	0.1633	0.1616	0.1599	0.1582
	tan	5.6713	5.7297	5.7894	5.8502	5.9124	5.9758	6.0405	6.1066	6.1742	6.2432
	sin	0.9877	0.9880	0.9882	0.9885	0.9888	0.9890	0.9893	0.9895	0.9898	0.9900
81	cos	0.1564	0.1547	0.1530	0.1513	0.1495	0.1478	0.1461	0.1444	0.1426	0.1409
	tan	6.3138	6.3859	6.4596	6.5350	6.6122	6.6912	6.7720	6.8548	6.9395	7.0264
	sin	0.9903	0.9905	0.9907	0.9910	0.9912	0.9914	0.9917	0.9919	0.9921	0.9923
82	cos	0.1392	0.1374	0.1357	0.1340	0.1323	0.1305	0.1288	0.1271	0.1253	0.1236
	tan	7.1154	7.2066	7.3002	7.3962	7.4947	7.5958	7.6996	7.8062	7.9158	8.0285
	sin	0.9925	0.9928	0.9930	0.9932	0.9934	0.9936	0.9938	0.9940	0.9942	0.9943
83	cos	0.1219	0.1201	0.1184	0.1167	0.1149	0.1132	0.1115	0.1097	0.1040	0.1063
	tan	8.1443	8.2636	8.3863	8.5126	8.6427	8.7769	8.9152	9.0579	9.2052	9.3572
	sin	0.9945	0.9947	0.9949	0.9951	0.9952	0.9954	0.9956	0.9957	0.9959	0.9960
84	cos	0.1045	0.1028	0.1011	0.0993	0.0976	0.0958	0.0941	0.0924	0.0906	0.0889
	tan	9.5144	9.6768	9.8448	10.02	10.20	10.39	10.58	10.78	10.99	11.20
	sin	0.9962	0.9963	0.9965	0.9966	0.9968	0.9969	0.9971	0.9972	0.9973	0.9974
85	cos	0.0872	0.0854	0.0837	0.0819	0.0802	0.0785	0.0767	0.0750	0.0732	0.0715
	tan	11.43	11.66	11.91	12.16	12.43	12.71	13.00	13.30	13.62	13.95
	sin	0.9976	0.9977	0.9978	0.9979	0.9980	0.9981	0.9982	0.9983	0.9984	0.9985
86	cos	0.0698	0.0680	0.0663	0.0645	0.0628	0.0610	0.0593	0.0576	0.0558	0.0541
	tan	14.30	14.67	15.06	15.46	15.89	16.35	16.83	17.34	17.89	18.46
	sin	0.9986	0.9987	0.9988	0.9989	0.9990	0.9990	0.9991	0.9992	0.9993	0.9993
87	cos	0.0523	0.0506	0.0488	0.0471	0.0454	0.0436	0.0419	0.0401	0.0384	0.0366
	tan	19.08	19.74	20.45	21.20	22.02	22.90	23.86	24.90	26.03	27.27

calafish_00287

ROA_03519

88	sin	0.9994	0.9995	0.9995	0.9996	0.9996	0.9997	0.9997	0.9997	0.9998	0.9998
	cos	0.0349	0.0332	0.0314	0.0297	0.0279	0.0262	0.0244	0.0227	0.0209	0.0192
	tan	28.64	30.14	31.82	33.69	35.80	38.19	40.92	44.07	47.74	52.08
89	sin	0.9998	0.9999	0.9999	0.9999	0.9999	1.000	1.000	1.000	1.000	1.000
	cos	0.0175	0.0157	0.0140	0.0122	0.0105	0.0087	0.0070	0.0052	0.0035	0.0017
	tan	57.29	63.66	71.62	81.85	95.49	114.6	143.2	191.0	286.5	573.0
Deg	**Function**	**0'**	**6'**	**12'**	**18'**	**24'**	**30'**	**36'**	**42'**	**48'**	**54'**

calafish_00288

ROA_03520

Standard Twist Drill Sizes

Designation	Diam. (In.)	Area (Sq. In.)	Designation	Diam. (In.)	Area (Sq. In.)	Designation	Diam. (In.)	Area (Sq. In.)
1/2	0.5000	0.1963	3	0.213	0.03563	3/32	0.0938	0.00690
31/64	0.4844	0.1843	4	0.209	0.03431	42	0.0935	0.00687
15/32	0.4688	0.1726	5	0.2055	0.03317	43	0.0890	0.00622
29/64	0.4531	0.1613	6	0.204	0.03269	44	0.0860	0.00581
7/16	0.4375	0.1503	13/64	0.2031	0.03241	45	0.0820	0.00528
27/64	0.4219	0.1398	7	0.201	0.03173	46	0.0810	0.00515
Z	0.413	0.1340	8	0.199	0.03110	47	0.0785	0.00484
13/32	0.4063	0.1296	9	0.196	0.03017	5/64	0.0781	0.00479
Y	0.404	0.1282	10	0.1935	0.02940	48	0.0760	0.00454
X	0.397	0.1238	11	0.191	0.02865	49	0.0730	0.00419
25/64	0.3906	0.1198	12	0.189	0.02806	50	0.0700	0.00385
W	0.386	0.1170	3/16	0.1875	0.02761	51	0.0670	0.00353
V	0.377	0.1116	13	0.185	0.02688	52	0.0635	0.00317
3/8	0.375	0.1104	14	0.182	0.02602	1/16	0.0625	0.00307
U	0.368	0.1064	15	0.1800	0.02554	53	0.0595	0.00278
23/64	0.3594	0.1014	16	0.1770	0.02461	54	0.0550	0.00238
T	0.358	0.1006	17	0.1730	0.02351	55	0.0520	0.00212
S	0.348	0.09511	11/64	0.1719	0.02320	3/64	0.0473	0.00173
11/32	0.3438	0.09281	18	0.1695	0.02256	56	0.0465	0.001698
R	0.339	0.09026	19	0.1660	0.02164	57	0.0430	0.001452
Q	0.332	0.08657	20	0.1610	0.02036	58	0.0420	0.001385
21/64	0.3281	0.08456	21	0.1590	0.01986	59	0.0410	0.001320
P	0.323	0.08194	22	0.1570	0.01936	60	0.0400	0.001257
O	0.316	0.07843	5/32	0.1563	0.01917	61	0.039	0.001195
5/16	0.3125	0.07670	23	0.1540	0.01863	62	0.038	0.001134
N	0.302	0.07163	24	0.1520	0.01815	63	0.037	0.001075
19/64	0.2969	0.06922	25	0.1495	0.01755	64	0.036	0.001018
M	0.295	0.06835	26	0.1470	0.01697	65	0.035	0.000962
L	0.29	0.06605	27	0.1440	0.01629	66	0.033	0.000855
9/32	0.2813	0.06213	9/64	0.1406	0.01553	67	0.032	0.000804
K	0.281	0.06202	28	0.1405	0.01549	1/32	0.0313	0.000765
J	0.277	0.06026	29	0.1360	0.01453	68	0.031	0.000755
I	0.272	0.05811	30	0.1285	0.01296	69	0.0292	0.000670
H	0.266	0.05557	1/8	0.1250	0.01227	70	0.028	0.000616
17/64	0.2656	0.05542	31	0.1200	0.01131	71	0.026	0.000531
G	0.261	0.05350	32	0.1160	0.01057	72	0.025	0.000491
F	0.257	0.05187	33	0.1130	0.01003	73	0.024	0.000452
E 1/4	0.2500	0.04909	34	0.1110	0.00968	74	0.0225	0.000398
D	0.246	0.04753	35	0.1100	0.00950	75	0.021	0.000346
C	0.242	0.04600	7/64	0.1094	0.00940	76	0.020	0.000314
B	0.238	0.04449	36	0.1065	0.00891	77	0.018	0.000254
15/64	0.2344	0.04314	37	0.1040	0.00849	78	0.016	0.000201
A	0.234	0.04301	38	0.1015	0.00809	1/64	0.0156	0.000191
1	0.228	0.04083	39	0.0995	0.00778	79	0.0145	0.000165
2	0.221	0.03836	40	0.0980	0.00754	80	0.0135	0.000143
7/32	0.2188	0.03758	41	0.0960	0.00724			

Note: Designations are in fractions of an inch, in standard twist drill letters, or in standard twist drill numbers, the latter being the same as steel wire gauge numbers.

calafish_00289

Subject Index

Accessories (Valve), 33-40
  functions, 35-40
  illustrations, 2-1 through 2-15

Actuator
  defined, 4
  diaphragm, 14
  electro-hydraulic, 16
  manual, 16
  piston, 15, 34
  replacing diaphragm, 101
  rotary-shaft valve, 7
  sizing, 79, 80
  styles available, 14, 15, 16, 91

Adjustment
  travel, 104-105
  zero deflection, 8

Air flow through
  Schedule 40 pipe, 160-163

American pipe flange dimensions, 175-178

Ammonia properties, 143-147

Area equivalents, 110

Atomic numbers, 121-123

Auxiliary equipment, 33-40
  functions, 35-40
  guidelines, 33-35
  illustrations, 2-1 through 2-15

Ball, V-notch
  defined, 6
  discussion, 22
  flow coefficients, 76-78
  illustrations, 1-8, 1-29

Bar stock material specifications, 127-129

Bar stock valve bodies, 18

Bernoulli's theorem, 62

Boiling point, 121-123, 130-134

Bolting
  limitations due to sour gas, 96
  materials, 127-129
  tightening sequence, 100

Bonnet
  bellows seal, 26
  definition, 1
  extension, 26
  function, 25
  illustrations, 1-1, 1-4, 1-5, 1-33

Booster, 33
  illustration, 2-3
  selection guidelines, 33, 34, 35

Butterfly valve
  definition, 7, 8
  discussion, 22
  face-to-face dimensions, 48
  flow coefficients, 76-78
  illustrations, 1-8, 1-28

Cage-guided trim
  characterization of, 30
  definition, 3
  illustrations, 1-1, 1-17, 1-21, 1-22, 1-37, 1-38

Capacity
  representative globe valve, 74-75
  representative rotary-shaft valve, 76-78

Casting specifications, 123-126

Cavitation
  description of, 65, 82
  illustrations of damage, 3-15
  noise, 82

Characteristics, 8, 9, 29
  definition, 9
  typical curves, 29
  selection of, 29, 60-62

Choked flow, 66

Circles
  circumference and area of 187-190

Cold box installation, 94

Control valve
  "boot", 21
  butterfly, 22
  nomenclature, 1
  rotary-shaft, 22, 23

calafish_00290

Globe-style valve body
actuator sizing for, 79
definition, 4
illustrations, 1-1, 1-6, 1-16, 1-17, 1-24, 1-26
recovery capability, 66-68, 74-75
typical sizing coefficients, 74-75

Gravity, specific
conversion to A.P.I. or Baume, 116, 117
of various hydrocarbons, 130-131
of various other fluids, 132-134
valve sizing consideration, 62

Greek alphabet, 193

Grinding metal seats, 103

Guiding of valve plug, 31
available styles, 31
illustrations, 1-1, 1-18, 1-20, 1-24

Handwheels, 36
function, 36
illustrations, 1-14, 2-4 through 2-7

High pressure service, 18, 89-91

High temperature service, 91, 92

Hydraulic snubber, 37
description, 37
illustration, 2-8

Hydrocarbons
physical constants, 130-131

Hydrogen embrittlement, 95

Installation, 97-100

Inch-millimeter equivalents, 107-110

Large-flow valves, 92, 93

Leakage classifications, 50

Length equivalents, 107

Limit switches, 37
function, 37
illustration, 2-9

Linear flow characterisitic, 29
description, 29
typical curve, 29

Line connections, 23-25, 90

Liquid penetrant examination, 80

Liquid sizing, 62
basic equation, 62

Lock-up systems, 38
description, 38
illustration, 2-12

Logarithms, common tables, 191-193

Magnetic particle examination, 80

Maintenance procedures, 28, 100-106

Manual actuators, 16, 1-15

Materials, 95, 96
elastomers, 51
forged, 18, 90
physical specifications, 123-126
popular metals, 42-43, 123-126, 127-129
pressure-temperature ratings, 44-47
temperature limits, 123-126

Melting point, 121-123

Metric prefixes and symbols, 193

Molecular weights
hydrocarbons, 130-131
miscellaneous fluids, 132-134

Motion transmitters, 35

Noise, 81-87, 93
control, 83
discussion, 81-87, 93
equipment illustrations, 1-22, 3-29 through 3-35, 4-8
prediction, 83

Nomenclature, 1-14

Non-destructive test procedures, 80, 81

Nuclear service valves, 95
packing, 28

Oxygen service
packing lubrication caution, 28

Packing, 27
arrangements, 1-34
lubrication, 28, 103
lubricator, 1-3
materials, 27, 28
replacement, 101

Path treatment for noise, 85-86

Pipe data, 165-185
standard dimensions, 166-174
tap sizes, 165
thread engagement, 165

calafish_00292

ROA_03523

Piping manifold dimensions, 98, 99

Piping practices, 100

Positioner, 33-35, 90, 91
electro-pneumatic, 40
guidelines, 33-35
schematics, 34

Pressure drop prediction, 63

Pressure equivalents, 112

Pressure retaining parts for nuclear service, 95

Pressure-temperature ratings, 44-47
bronze valves, 47
cast iron valves, 47
steel valves, 44-46

Quick opening characteristic, 29, 30
description, 30
typical curve, 29

Radiographic examination, 81

Recovery capability, 65
description, 66-68
curves, 68

Representative sizing coefficients
globe-style bodies, 74-75
rotary-shaft bodies, 76-78

Resonating, natural frequency, 82

Rotary-shaft body
actuator mounting positions, 104-105
actuator sizing, 80
definition, 8
illustration, 1-8
typical sizing coefficients, 76-78

Seat ring replacement, 102

Selection considerations, 41

Silencer, inline, 86

Sizing, 62
actuator, 79, 80
equations, 62-73
typical coefficients, 74-78

Small-flow valves, 92

Snubber, hydraulic, 37

Soft-seating, 21

Solenoid valve manifold, 38
function, 38
illustration, 2-10

Source treatment for noise, 83-85

Sour gas service guidelines, 95, 96

Special control valves, 89
cryogenic service, 93, 94
high pressure, 89-91
high temperature, 91
large-flow, 92
nuclear service, 95
small-flow, 92
subject to sulfide stress cracking, 95, 96

Specifications
bar stock materials, 127-129
casting materials, 123-126
elements, 121-123
hydrocarbons, 130-131
needed to order valve, 42

Specific gravity, 62, 116-117, 130-134

Steam
properties table (saturated), 136-142
properties table (superheated), 148-153
sizing procedure, 69-72
tracing, 90

Sulfide stress cracking, 95, 96

Temperature limits, 28
elastomers, 60
metals, 51
packings, 28

Terminology, 1, 6, 8, 11
general control valve, 1
miscellaneous, 11
rotary-shaft valve, 6
valve functions, 8

Test procedures
determination of leakage class, 50
non-destructive examination, 80, 81

Transducer, electro-pneumatic, 39
function, 39
illustration, 2-14

Travel adjustment, 104-105

Trim, 29-31
characteristics, 29, 30
definition, 6
material temperature limits, 51
replacement, 102
restricted capacity, 31

calafish_00293

ROA_03524

Trigonometric functions, 194-204

Ultrasonic examination, 81

Universal Gas Sizing Equation, 71

Valve body
angle-style, 18
bar stock, 18
boot-style, 21
butterfly, 22
cryogenic, 93-95
double-ported, 20
eccentric disc, 23
forged, 18
high-pressure, 18
installation, 97-100
maintenance, 100-106
materials, 42
reverse-acting, 20
rotary shaft, 8
selection of, 41
single-ported, 17, 18
single-seated, 17
styles, 17-23
three-way, 21
V-notch ball, 22

Valve plug, 29
balanced, 19
characteristics, 29
unbalance, 79

Valve sizing, 62
basic liquid sizing equation, 62
gas or steam service, 69-72
liquid/gas mixtures, 72-73
liquid service, 62-69
noise applications, 86-87
Universal Gas Sizing Equation, 71

Vapor pressures
hydrocarbons, 130-131
miscellaneous fluids, 132-134

Velocity of liquids in pipe, 154-155

Vena contracta, 65
description, 65
illustration, 3-12

Vent diffuser, 85
discussion, 85
illustration, 3-31

Vibration noise, 82

Viscosity
effect on sizing, 63
nomograph, 64, 119

Volume booster, 33-35
guidelines, 33-35
illustration, 2-3

Volume equivalents, 111

Volume rate equivalents, 111

V-notch ball control valves
description, 22
dimensions, 49
illustrations, 1-8, 1-29
typical flow coefficients, 76-78

Water
flow in Schedule 40 pipe, 156-159
properties of, 135

Wear resistance of material, 49

Zero deflection, 8

calafish_00294

ROA_03525

CURRICULUM VITAE

NAME: **John Coulter Maddox**
Birthdate: January 30, 1950, In Bedford, VA

COLLEGE: University of Virginia, College of Arts & Sciences
BA with Distinction in Biology in 1972
Dean's List 6 of 8 semesters
Phi Sigma Society (Biology Honorary)

MEDICAL SCHOOL:
University of Virginia, School of Medicine M D. in 1976

BOARD CERTIFICATION:
Anatomic and Clinical Pathology (American Board of Pathology, 1982)
Voluntary Recertification (American Board of Pathology, 1998)
Hematology (Pathology) (American Board of Pathology, 1998)

LICENSURE: Virginia # 0101032554

POST GRADUATE TRAINING:
Stanford University Medical Center, Stanford, California.
Department of Pathology: *Intern and Resident in Anatomic Pathology, 1976-1979, Chief Resident, 1978.*

M D Anderson Hospital & Tumor Institute, Houston, Texas
Branch of the University of Texas: *Fellow in Anatomic Pathology, 1979-1980.*

Medical College of Virginia, Richmond, Virginia. Branch of Virginia Commonwealth University, Department of Pathology: *Resident in Clinical Pathology, 1980-1981, and Fellow in Hematopathology, 1981-1982.*

CURRENT PRACTICE:
Riverside Regional Medical Center
Pathology Department
500 J Clyde Morris Blvd.
Newport News, VA 23601
(757) 594-2870 -2951 FAX
john.maddox@rivhs.com

rev. 3-15-2016



ARTICLES:

Roggli, Hammar, Maddox, and Henderson: Re: The "Helsinki Criteria" for attribution of lung cancer to asbestos exposure: how robust are the criteria? Arch Pathol Lab Med. 2008 Sep;132(9):1386-1387.

Green, Maddox & Huttenbach: Linezolid and Reversible Myelosuppression (Research Letter) JAMA 285(10):1291, March 2001. In reply JAMA 286(16):1974, Oct.2001.

Legier & Maddox: Massive Ovarian Lymphatic Displacement of Granulosa Cells. Journal of Surgical Pathology 2 1-2,1996

Roggli, Hammar, Pratt, Maddox, Legier, Mark & Brody: Commentary - Does Asbestos or Asbestosis Cause Carcinoma of the Lung? American Journal of Industrial Medicine 26: 835-838 1994

Legier & Maddox: "Immunohistochemical Diagnosis of Mesothelioma," in the monograph The Mesothelial Cell and Mesothelioma, Marie-Claude Jaurand and Jean Bignon, editors, in the series Lung Biology in Health and Disease vol 78, Claude Lenfant, executive editor Marcel Dekker, Inc. New York, 1994, pages 103-119.

Craighead, Calore, Corson, Copeland, Maddox, and Sporn: The pathogenic role of growth factors in human and rat malignant mesotheliomas. Eur Respir Rev. 1993, 3:11, 159-160.

McClellan, Maddox & Innes: Platelet Vacuoles in Acute Megakaryoblastic Leukemia. American Journal of Clinical Pathology 92.700-702,1989

Behm, Maddox & deBlois: Systemic Mastocytosis. ASCP Check Sample in Anatomic Pathology 10(10), AP82-I0, 1982.

Maddox & Evans: Angiosarcoma of Skin and Soft Tissues: A Study of 44 Cases. Cancer 48:1907-1921, 1981.

Ryning, McLeod, Maddox, Hunt & Remington: Probable Transmission of *Toxoplasma gondii* by Organ Transplantation. Ann Intern Med 90:47-49, 1979.

ABSTRACTS:

Finkelstein & Maddox Needle Biopsy with Flow Cytometry in the Diagnosis of Lymph Node Malignancies. Virginia Society of Hematology & Oncology, June 1998.

Maddox & Harden: The Riverside Lymphoma Experience, 1986 - 1994 Virginia Society of Hematology & Oncology, June 1996.

Maddox & Behm: Immunoblastic Lymphoma of the Breast in a Patient with Waldenstrom's Macroglobulinemia. Virginia Society of Hematology, June 1982.

Maddox & Behm: Coexisting Mycosis Fungoides and Hodgkin's Disease. Virginia Society of Hematology, June 1981 (also printed in Virginia Medical Monthly 108(10) 673, October 1981.

rev. 3-15-2016

SPEAKER:

Perrin Asbestos Conference, September 19-21, 2011. San Francisco, CA. "Advancement In Asbestos Medicine." Invited panelist, along with Drs. Roggli, Graham, and Brody.

AWARDS:

Honorable Mention (5th Place), M D. Anderson Hospital 1980 Annual Clinical Research Project Competition.

Clinical Fellowship of the American Cancer Society (Pathology - Hematology. 1981-1982).

PROFESSIONAL ORGANIZATIONS:

Houston Society of Clinical Pathologists, 1979-80.
Richmond Blood Club, 1980-1982.
Tissue Culture Association, National Capitol Area Branch, 1981-1982
College of American Pathologists, 1982-present
Newport News Medical Society, 1982-present
Virginia Society for Pathology, 1981-present; Program Director, 1988 & 1991, Delegate to Medical Society of Virginia, 1989-1993; Board of Directors, 1989-1995, President, 1991
Virginia Society of Hematology and Oncology, 1980-present
American Society of Hematology, 1987-present
Medical Society of Virginia, 1989-present
Tidewater Pathology Society, 1982-present
Pulmonary Pathology Society, 2001-present

PROFESSIONAL ACTIVITIES:

Flow cytometry - read 300 cases / year
Bone marrow exams - draw 175+ / year, read 275 / year
Molecular genetics – read 175+ FISH evaluations / year
Lung pathology (Asbestos related disease), about 100 consults per year
Mansville Trust Review Panel, member, 1989-present.

Hematology Section Director (RRMC)- 358,000 automated procedures/ yr

Electron Microscopy - started and directed service from 1984-2000, JEOL 100CX TEM, SEM; Also, Energy Dispersive X-ray Microanalysis, using Kevex 7000, EDAX 9900, and JEOL Electron Microprobe.

Flow Cytometry - started and developed service from 1988-present, Certificate from Coulter School of Flow Cytometry.

HOSPITAL COMMITTEES:

Surgical Case and Blood Utilization Review Committee, 1984-1993; Chairman 1985-90.
Oncology Committee, member 1989 – 2007.
Medical Quality of Patient Care Committee, member 2007 – present.
Radiation Safety Committee, member 1990 - 2003.
Executive Committee, Hampton Roads Specialty Hospital, 2006–present.

rev.3-15-2016

INDEX

MEMORANDA

1. Plaintiffs' Exhibit **1008.9774**:

   07/15/1985 - Fisher memo to Plant Managers, subject *Asbestos Elimination Program*

2. Plaintiffs' Exhibit **1008.1497**:

   09/26/1985 - Fisher memo to All Sales Reps (US, Asia, & Latin America), subject *Asbestos Elimination Program*

3. Plaintiffs' Exhibit **1008.1498**:

   11/01/1985 - Fisher memo: remaining stock of asbestos gaskets, subject *Asbestos Replacement Program*

4. Plaintiffs' Exhibit **1008.1496**:

   12/17/1985 - Fisher memo, subject Asbestos Elimination Program (update)

5. Plaintiffs' Exhibit **1008.1495**:

   01/05/1987 - Fisher memo, subject Asbestos Gaskets and Packing (update)

6. Plaintiffs' Exhibit **1008.1494**:

   03/03/1987 - Fisher memo, subject Asbestos Elimination Program, beginning to phase out A-C packing.

7. Plaintiffs' Exhibit **1008.1493**:

   April 1987 – Fisher Control's *The Control Line*, Fisher employee newsletter, Issue No. 251, subject Asbestos Elimination Program

8. Plaintiffs' Exhibit **1008.1492**:

   11/03/1987 - Fisher memo from Roy Brodin, subject Asbestos in Fisher Products

9. Plaintiffs' Exhibit **1008.1490**:

   01/26/1985 - Fisher memo from Dale Stepanek, subject Asbestos Elimination Program

MATERIAL SPECIFICATIONS

1. Plaintiffs' Exhibit **1008.1955**:

   02/15/1988 - Fisher Mat. Spec.: High Grade Long Fibre Asbestos Sheet Gasket material

2. Plaintiffs' Exhibit **1008.1956**:

   02/22/1988 - Fisher Mat. Spec.: High Grade Long Fibre Asbestos Sheet Gasket material

3. Plaintiffs' Exhibit **1008.1957**:

   09/13/1983 - Fisher Mat. Spec.: High Grade Long Fibre Asbestos Sheet Gasket material

   - Shows approved materials: Durabla and Johns Manville JM78

4. Plaintiffs' Exhibit **1008.1959**:

   02/15/1988 - Fisher Mat. Spec.: Asbestos Gasket Sheet with Non-Sticking Qualities

**Specifically mentions "when clamped between flanges it must not stick to the flanges"

5. Plaintiffs' Exhibit **1008.1960**:

   02/15/1988 - Fisher Mat. Spec.: Asbestos Gasket Sheet with Non-Sticking Qualities

   - Shows approved materials: Garlock Style No. 900/7735 and Nicollet No. 240.

6. Plaintiffs' Exhibit **1008.1964**:

   02/15/1988 - Fisher Mat. Spec.: Heavy Duty Elastomer-Bound Asbestos Gasket Material Specification listing approved sources of nitrile elastomer bound asbestos gasket material.

   *Shows approved materials: Armstrong Accobest AN-8012.

7. Plaintiffs' Exhibit **1008.1963**:

   02/15/1988 - Fisher Mat. Spec.: Heavy Duty Elastomer-Bound Asbestos Gasket Material Specification listing approved sources of nitrile elastomer bound asbestos gasket material.

- Shows approved materials: Armstrong Accobest AN-8012.

8. Plaintiffs' Exhibit **1008.1964**:

02/15/1988 - Fisher Mat. Spec.: Heavy Duty Elastomer-Bound Asbestos Gasket Material Specification listing approved sources of nitrile elastomer bound asbestos gasket material.

- Shows approved materials: Armstrong Accobest AN-8012; John Crane Super-Seal No. 3; Garlock No. 235; Garlock No. 233; Palmetto String Packing

9. Plaintiffs' Exhibit **1008.1971**:

04/15/1987 - Fisher Mat. Spec.: Graphited Asbestos Packing

Specification listing approved sources of graphited asbestos packing material.

- Shows approved materials: Argo Packing Co.

10. Plaintiffs' Exhibit **1008.1972**:

04/15/1987 - Fisher Mat. Spec.: TFE Asbestos Packing. (Graphited Asbestos Packing)

Specification listing approved sources of graphited asbestos packing material

- Shows approved sources of materials: Argo Packing Co. and Martin Merkel Packings

11. Plaintiffs' Exhibit **1008.1973**.

04/11/1986 - Fisher Mat. Spec.: High Temperature Aluminum Packing

Specification listing approved sources of graphited asbestos packing material

- Shows approved sources of materials: Durametallic Style D-110 or D-10 for metallic rings and Durametallic Style D-222 or D-2 for plastic rings.

12. Plaintiffs' Exhibit **1008.1977**.

04/22/1987 - Fisher Mat. Spec.: Square Braided Asbestos – Graphite Packing

Specification listing approved sources of graphited asbestos packing material

- Argo Packing Co.
- Johns-Manville Style No. 2014
- Garlock, Inc. No. 5561
- Martin Merkel, Inc.

13. Plaintiffs' Exhibit **1008.2331**

07/01/1986 - Fisher Mat. Spec.: Special Handling for Low-Chloride Gasket Material

Specification listing approved sources: Flexitallic spiral wound gaskets

14. Plaintiffs' Exhibit **1008.2332**

07/25/1985 - Fisher Mat. Spec.: Special Handling for Low-Chloride Gasket Material

Specification listing approved sources: Flexitallic spiral wound gaskets

CONFIDENTIAL

FISHER

Memorandum

To: Plant Coordinators

From: Dale Stepanek - Marshalltown

cc: Tony Casciato
Larry Solley

Date: July 15, 1985

Subject: Asbestos Elimination Program

fyi to: Glenn Johnson
xc: Cliff Fisher
Tom Black - G2WB
Ray Winter - C57W
Ken Miller
4-16-85 KM

Congratulations on your selection as Plant Coordinator for the Asbestos Elimination Program at your location. I look forward to working with you on this important corporate objective. As a Plant Coordinator, you are requested to assume the responsibility for implementing this program in your area. Your efforts will be vital to the success of this project.

The Asbestos Elimination Program was initiated as a result of the increasing safety and liability concerns of our customers and suppliers, many of whom have already eliminated asbestos from their products. Our goal on this program is to eliminate asbestos from all Fisher products by the end of 1985.

Enclosed, you will find an asbestos elimination timetable. This graphically shows key events and the estimated durations required to meet our year-end mandate. Specific activities and timeframes will vary from site to site, but generally, each site will need to:

1. Identify affected in-house parts.
2. Procure approved substitutes.
3. Phase-in new parts/phase-out old parts.*
4. Modify local literature, if applicable.
5. Publicize program where appropriate.

*We have targeted November 1, 1985, as the date we will begin to scrap any remaining asbestos stock. This will allow us two months to resolve any problems before our year-end deadline.

I would like each of you to submit a Site Activity Plan by August 15, 1985. I have enclosed, as an example, the Site Activity Plan for Marshalltown. ——— Not Enclosed These plans are not intended to be binding contracts, but a way for us to identify the key activities and individuals involved at each plant. They will also help us recognize any situation at your site requiring special support or coordination.

EXHIBIT 1008.9774

EXHIBIT 10

Litigation Services

calafish_09774

CONFIDENTIAL

You will find product release documents included in this packet covering flat sheet, spiral wound, and metal jacketed gaskets. The description explains how substitute gaskets are to be handled. Please read this document carefully and determine how these changes relate to your location. The attached parts list includes all affected gaskets within the Fisher system. You will later receive similar documents covering valve packing. Only approved materials as described in the enclosed Fisher material specifications should be used for replacement.

I will be providing additional information and program updates as the year progresses. Let me know if I can answer any questions or provide assistance in any way. Thanks in advance for your support and cooperation.

Regards,

Dale Stepanek

Dale Stepanek

5520/DS:mc

Enclosure

CONFIDENTIAL

FISHER

Memorandum

To: ALL NORTH AMERICA, EMA, ASIA-PACIFIC AND LATIN AMERICA SALES REPRESENTATIVES

From: Dale Stepanek - Marshalltown

cc: Larry Mueller
Larry Solley
Jim Teegarden

Date: September 26, 1985

Subject: Asbestos Elimination Program

All Fisher sales offices and representatives should be aware of a company-wide program to eliminate asbestos from Fisher products. This has come as the result of an industry-wide movement to discontinue the use of this controversial material. Many suppliers, manufacturers, and end-users have already implemented asbestos substitution programs within their companies. Fisher's goal is to remove asbestos containing parts from all stock and inventories by the end of this year. After that time, asbestos containing parts will be made available only on a special order basis to accommodate specific customer needs.

Parts affected by this program include gaskets and valve packing. Flat sheet gaskets containing asbestos will be replaced in all products by aramid fiber/nitrile gaskets up to 450°F and graphite gaskets above 450°F. Asbestos fillers in spiral wound gaskets will be replaced by mineral based fillers. Users of oxygen service products should be consulted on an individual basis to determine satisfactory gasket substitutes. Asbestos containing packing will not be available as a Price Book option after this year. Major suppliers, including Crane, Garlock, and Parker no longer offer asbestos containing packing and the material is becoming difficult to obtain. Fisher has initiated a project to identify and evaluate new packing substitutes and the results will be communicated as they become available.

You are encouraged to discuss this matter with your customers, especially those who currently specify asbestos containing parts. We must be firm yet flexible in handling this situation with a minimum impact on our customers. Their sensitivity in accepting these changes must be determined and maximum efforts made to accommodate them during this transition. It is important that everyone realize Fisher is attempting to serve their interests in the best way possible.

Please keep us advised of problems and progress.

Dale Stepanek

Dale Stepanek

5520/ee

APPROVED BY: A. C. Casciato

FC_1497

PLAINTIFF'S EXHIBIT 1608.1497

CONFIDENTIAL

FISHER

Memorandum

To: Ron Patton, Kevin Mogard, Max Montz, Dale Dolezal, Herb Rickert, Neal Fogle, Rick Miller, Jane Tesar

From: Mike Wells

cc: Craig Anderson, Bill Landholt, Dale Stepanek, Fred Luthe, Gary Icenogle, Cliff Viers, Larry Fleetwood, Gary Petermeier

Date: November 1, 1985

Subject: Asbestos Replacement Program
October 23, 1985 Meeting Minutes

The meeting on October 23, 1985, was held to update the status of the asbestos elimination efforts at Fisher's Marshalltown site and to determine what steps need to be taken to finalize this project. Although the program initially addressed gaskets only, packing materials will now be included in the project scope.

GASKETS

By the end of May, 1985, Design Engineering had changed the material codes on all gaskets containing asbestos to non-asbestos codes. Any new orders for gaskets were purchased to the new gasket material specifications. Stores personnel were instructed to rotate gasket stock to use the asbestos containing gaskets first. It was anticipated that stocked gaskets would turn over quickly enough that normal stock rotation would deplete inventory of asbestos gaskets by the target date. Slow turn-over and non-stock items would be monitored by Inventory Control. If normal turnover did not deplete stock, gaskets to the new material specifications would be ordered and old stock would be purged. The process of purchasing non-asbestos gaskets to complete this phase was started early in October.

Two problems have been identified. The first involves oxygen service valves. No suitable non-asbestos gasket has been agreed upon between Fisher and our customers for this critical service. Until a replacement is found and adequately tested, we will continue to provide asbestos gasket material for oxygen service only. The second problem involved the need for a tighter tolerance on sixteen gaskets for E-bodies than was called out on the general specification. Changes have been made to correct this problem, and Cooper is sorting gaskets to provide us stock with the proper tolerances.

The following plan of action will be used to purge the remaining asbestos gaskets from stock and dispose of them:

1. Inventory Control will supply a list of part numbers of all asbestos containing gaskets to Herb Rickert.
2. Stores personnel will perform a physical inventory on these items. They will provide a count of asbestos and non-asbestos gaskets at each stock location. For metal jacketed gaskets, stores will count by package dates before and after June 1, 1985.
3. Inventory Control will determine if stock of non-asbestos gaskets is adequate to meet production needs. Where adequate stock of new gaskets is available, Inventory Control will provide those part numbers to Stores to purge the asbestos gaskets. For those part

FC_1498



numbers where stock is not available or is presently on order, those parts will be purged only when new gaskets are available.

4. Stores will remove all asbestos containing gaskets from stock and remove to a designated holding area for hazardous materials. They will also check that the non-asbestos gaskets left in stock are correctly labeled. Gaskets should be scrapped to the obsolete inventory account.
5. When all asbestos gaskets are purged, material will be disposed of at the landfill using proper handling and disposal procedures provided by Sam Cheng.

Additionally, operations needs to inform the shop to clean out all extra gaskets in bench stock and remove to the holding area for disposal.

Marketing needs to send out a note to service centers and representatives to stop returned goods for gaskets (restocking of asbestos gaskets at Fisher Marshalltown).

Cost accounting will be informed of increased gasket costs for the next implosion.

Herb Rickert will have his people purge any asbestos gaskets from the unallocated warehouse.

Parts kits and Supermarket items will not be torn down to change out gaskets. Gaskets that have been allocated for existing orders will not be changed over.

Cost impact of scrap will be available after the physical inventory by Stores.

PACKING

The original intent of Engineering was to replace all asbestos containing packing materials with either Teflon (TFE) or grafoil type materials. Both of these materials are currently approved and used at Fisher. Neal Rinehart and Dale Stepanek recently attended a VMA Technical Seminar on New Packing and Gasket Materials. At this seminar, many companies expressed concern about eliminating asbestos packing materials without extensive testing on proposed replacement materials to assure compatibility with their processes. Because many of Fisher's major customers are in agreement with these views, we need to be able to continue to supply asbestos containing packing where requested. Customers will be directed toward using the non-asbestos packings where feasible. Further complicating matters, several of our major packing vendors (including Crane) have stopped producing asbestos containing packing.

Engineering has undertaken a two-part testing program to address the packing problem. The first part of the program is aimed at testing asbestos containing packing materials from new vendors. This will enable Fisher to supply packing materials until appropriate non-asbestos replacements can be found. The search for and approval of replacement packing is the second part of the testing program. This part will include in-house testing of non-asbestos substitutes over the next 3-6 months and possible field testing to assure customer acceptance.

CONFIDENTIAL

At this time, purchasing is involved in supporting the search for new vendors of both asbestos and non-asbestos packing. No stock will be purged until further direction is obtained from Engineering and Marketing.

If there are any questions concerning the direction being taken on the replacement of asbestos gaskets or packing, please contact me.

Sincerely,

Mike Wells

Mike Wells

/kt

[redacted]

[redacted]

FC_1500

CONFIDENTIAL

FISHER

Memorandum

To: Distribution List

From: Dale Stepanek

cc: Tony Casciato
Larry Solley

cc: Glenn Johnson
Tom Blount-02013
Rib

Date: December 17, 1985

Subject: ASBESTOS ELIMINATION PROGRAM UPDATE

Fisher's asbestos elimination program is progressing smoothly with excellent cooperation from all plant locations. Existing inventories of asbestos containing gaskets and packing are being depleted. We will be in a position to effectively provide to customers Fisher products without asbestos containing parts by January 1. Although our program has progressed extremely well it is now clear that many of our major customers are only just beginning to consider asbestos elimination programs. There is evidence that many customers are not willing to immediately make the transition from asbestos gaskets and packing until they have completed their own internal testing of alternate materials.

To ensure that we continue to be responsive to customer needs Fisher will be required to provide, on a special order basis, products containing asbestos materials for some time yet in the future. Recognizing this, and to ensure that we do not precipitously write-off unused inventories of gaskets and packing, we have extended the target date for transition on standard products to non-asbestos materials to April 1, 1986. After this date, products containing asbestos materials will be provided only on a customer order basis and we do not intend to maintain any inventory parts containing asbestos materials.

Response to the asbestos elimination program has been very positive and it is important that Fisher assume a leadership role in executing this transition. Your continued support will be appreciated and if there are any questions or concerns please contact me.

Dale Stepanek

Dale Stepanek

/mak

FC_1496

PLAINTIFF'S EXHIBIT 1008.1496

PENGAD 800-631-6989

CONFIDENTIAL

TO: Ron Allen
Jeff Klatt

FROM: Roy Bradin

CC: Ted Imsland
Herb Rich

DATE: January 5, 1987

SUBJECT: Asbestos Gaskets and Packing

At the December meeting of the LPPB, I was asked to check on the status of asbestos parts used in Fisher products. The status is as follows:

Packing

A non-asbestos substitute material has been identified. The problem is how to make the implementation - which is primarily a documentation problem. A main consideration is traceability. If we simply redefine the existing Material Reference Nos. and use the existing part numbers, we will not have traceability. However, we probably will do just that and scrap the old stock. It will probably be mid-1987 before the implementation is complete.

If a customer insists on asbestos packing we may still provide it if we can obtain the packing. However, some suppliers of packing, such as Crane, are getting out of the asbestos packing business, so we will reach the point where we simply refuse to provide it.

Gaskets

Asbestos containing gaskets have been replaced with gaskets that do not contain asbestos, except that several flat sheet asbestos gaskets that have been used in oxygen service are presently still active. These will be obsoleted as soon as Marketing can determine our oxygen service customers' preference for acceptable alternate materials.

All asbestos containing gasket stock was purged from the Marshalltown inventory on April 20, 1986, except that subsequently a small amount of sheet stock was purchased for making gaskets for oxygen service.

Listings of the affected part numbers were sent, by the Marketing Product Manager, to the assigned site coordinator at each Fisher site so that the asbestos elimination could be coordinated throughout all Fisher sites.

We will continue to provide asbestos gaskets if the customer insists. — *ltw y/Ltr 7*

Roy

FC_1495

PLAINTIFF'S EXHIBIT 1008.1495
PENGAD 800-631-6989

CONFIDENTIAL

FISHER

Memorandum

To: All U.S. Representatives
(Main Offices Only)
ATTN: President

From: Kent Rummelhart -
Marshalltown

cc: Dale Stepanek
Dan Button
Kevin Mogard
Area Sales Directors

Date: March 23, 1987

Subject: Asbestos Elimination Program

Fisher Controls is in the final phase of our Asbestos Elimination Program. After this year, our policy will be to supply no parts or assemblies containing asbestos under any circumstances. This will require the elimination of all remaining asbestos containing inventories (primarily packing) during 1987.

Asbestos containing gaskets have already been removed from our worldwide inventories. With successful tests completed on packing substitutes, equal or superior materials have been identified for all previous asbestos containing valve parts. Engineering documentation on packing parts is currently being revised to reflect the new materials.

Effective immediately, Marshalltown and Sherman will begin phasing out asbestos containing packing. The complete elimination of asbestos containing packing inventories will be realized on or before July 1, 1987 in Sherman and Marshalltown.

All sites worldwide will dispose of any remaining asbestos containing parts once and for all by December 31, 1987.

For your reference, a list of affected packing part numbers and material codes are attached. Part numbers for the new packing will remain the same with only material codes changing. Previous information has been distributed concerning asbestos packing discontinued by our suppliers and recommended substitutes.

If you have any questions regarding this correspondence or the Asbestos Elimination Program in general, please contact me at 515-754-3680 in Marshalltown.

Please see that this is distributed to the proper people within your organization. Thank you for your cooperation.

Kent Rummelhart
Application Engineer

5520/KR:mc

Attachment

APPROVED BY: James A. Carey
James A. Carey

FC_1494

PLAINTIFF'S EXHIBIT 1008.1494

PENGAD 800-631-6989

FISHER

41

DALE STEPANEK

CVR MKTG

MO

CONFIDENTIAL

The Control Line

Issue Number 251 April 1987

Asbestos Elimination Update

Fisher is in the final phase of its worldwide asbestos elimination program. Testing is complete and equal or superior non-asbestos materials have been identified for all asbestos containing valve parts.

Marshalltown and Sherman will begin phasing out asbestos containing packing immediately, with complete change over to be realized on or before July 1, 1987.

All sites worldwide will dispose of any remaining asbestos containing inventories on or before December 31, 1987. After December 31, 1987, our policy will be to supply no asbestos containing parts or assemblies under any circumstances.

If you have any questions regarding this program, call Kent Rummelhart, Dan Stedham or Dale Stepanek in Marshalltown.

Rationalization: Regulators/Strainers/Filters

This is a reminder that Fisher is dropping some offerings due to extremely low sales volume. Orders for the following 'series' products will be filled only as long as inventory is available: 67G, 67GR, 67Y, 67YR, 122, 155, 2899, 413, 610, 611, 612, 613, 252C (1/4 & 1/2-inch sizes only), 260B, 260C (1/4, 3/8, 1/2 & 1 1/4-inch sizes only) and P595.

McKinney Phone System Adds D.I.D. Service

Effective Monday, April 6, McKinney telephone system will provide Direct-In-Dialing service for all incoming calls. It was necessary to change the existing 200-series internal extension numbers to 500-series numbers. (Example: Ext. 211 changed to Ext. 511.) The 100-series numbers will not changed.

To place a D.I.D. call to McKinney, dial 214-548-3 + (3-digit ext.#).

If you have any questions or problems with this service, please call Barbara Fletcher (214-548-3114).

Training More Flexible With On-Site Schools

The Fisher Education courses as presented at the factory training centers are designed to satisfy the requirements of a broad client base. To satisfy the specific needs of an individual client, course content can be focused to specialized interest areas for delivery at the factory, at your office, or at the clients' locations.

Customized on-site schools have recently been conducted by the Educational Services group for GE, Amoco, 3M, Monsanto, Eastman Kodak, Chevron, Weyerhaeuser, Union Carbide, Mobay Chemical and others.

A price sheet with on-site school offerings for 1987 is included in the April mailing of catalog publications and should be added to your Order Entry Document Vol. II book. Commissions will be given for factory training conducted at a customer's location or at your office.

For further information on availability and pricing, contact Dorothy Hollberg, Marshalltown Education at Ext. 3700.

School Status Report *(As of 3-24-87)*

Course #	Schools	Dates	Spaces Avail
PROVOX HP Based			
4000	Configuration I	Apr. 20-24	8
		June 1-5	14
4100	Configuration II	June 8-12	16
4200	UOC	Mar. 16-27	1
		May 4-15	2
4300	CHIP	Apr. 6-10	7
		June 8-12	13
4400	Maintenance	May 4-15	21
3000	ec² Maintenance	Apr. 6-10	15
PROVOX DEC Based			
5000	Controller	June 1-5	8
5100	Systems	Apr. 6-10	7
		Apr. 27-May 1*	1
		May 4-8	10
		May 11-15*	1
		June 8-12	Full
5200	UOC +	Apr. 20-May 1	2
		June 1-12*	8
		June 15-26	5
5300	IFC	June 15-19*	6
5400	CHIP (DEC PRO)	Apr. 20-24*	9
		May 18-22*	10
5500	System Maintenance	Apr. 20-May 1	9
		June 15-26	0
FCS/MUniversal			
8002	Chemical Industry Conference	May 4-8	15
1300	Valve Engineering	May 11-15	10
0230	Sys/UOC + Transition (Rap)	May 18-22	2
1100	Instrument Engineering	May 18-22	12
0020	Selling Skills	May 27-29	15
0210	DEC PRO 380 Maintenance	May 28-29	5
0220	DEC Console Maintenance	June 1-5	Full
0115	Control Valve Seminar	June 2-3	45
1000	Gas Conference	June 15-19	34
1400	Valve Technician	June 22-26	14
1200	Pneumatic Inst. Tech.	June 29-July 2	18

*Austin school

MI Success Stories On Video-Tape

To assist the field sales effort on behalf of MI products, a video-tape set titled "MI Success Stories" is being distributed to all North American representative offices. The stories are presented by Fisher inside and outside salespeople during MI schools.

The tapes discuss door-opening techniques, competitive selling, actual sales calls, problem solving and sales strategies used in bolstering MI sales and promoting Fisher as the total loop solution.

If you have not received your office's package by April 15, please contact Kevin Wilbeck in Austin (Ext. 7687).

FC_1493

PLAINTIFF'S EXHIBIT 1008.1493

PENGAD 800-631-6989

CONFIDENTIAL

FISHER

Memorandum

To: Ron Allen – GR
Terry Buzzbee GR

From: Roy Brodin

cc: Al Hays
Ted Insland

Date: November 3, 1987

Subject: Asbestos in Fisher Products

At the October LPPB meeting, I reported that as of this past summer Marshalltown was not, and would not, ship any products containing asbestos. Terry raised the question about the 20" EH's for AEP that are shipped with non-asbestos packing knowing that AEP is replacing that with packing that contains asbestos.

I discussed this with Al Hays. We are experiencing field problems with the non-asbestos packing in that we are not getting the life we want. There is an active project to solve this problem. However, AEP wanted an 18 month life and found that they could achieve this with Argo packing, which contains asbestos. We have tested this packing and are using it for comparison purposes. Anyway, we are shipping these EH valves with non-asbestos packing that does work, but not as well as we would like.

Roy

Roy Brodin

FC_01492

PLAINTIFF'S EXHIBIT 1008.1492

CONFIDENTIAL

FISHER

Memorandum File 6.6

To: Milt Blevins
Caltrol

-- FAX --

From: Dale Stepanek

cc: K. Rummelhart

Date: January 26, 1989

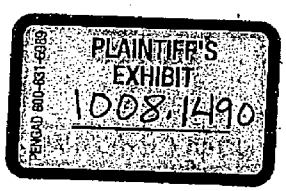
Subject: ASBESTOS ELIMINATION PROGRAM

Attached is the last correspondence to the field regarding the asbestos elimination program. Total elimination of asbestos from Fisher parts and assemblies was completed on schedule as indicated on December 31, 1987. All Fisher products shipped after this date have been and will continue to be asbestos free.

Regards,

Dale Stepanek

/jo



FC_01490

Fisher Controls	Material Specification	No. FMS 17A2 E
FISHER®	HIGH GRADE LONG FIBRE ASBESTOS SHEET GASKET MATERIAL	By CWW 8-1-13
		Apvd TKB 9-14-82
		Page 1 of 1
©Fisher Controls 1983		Rev WHH 2-15-88

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for elastomer bound asbestos gasketing and describes the composition of the approved source(s), their surface resistance, general usage, product name; and all approved substitutes for the approved sources.

2. MATERIAL REFERENCE NO. 0402

3. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% elastomeric binder.

4. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

5. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

6. MATERIAL SUBSTITUTION

The approved material(s) listed under FMS 17A4 may be substituted for the approved material(s) listed below. The substitution may be made provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS 17A2 material.

FMS 17A2 material may not be substituted for FMS 17A4 material.

7. APPROVED SOURCE(S)

The following material(s) have been approved:

OBSOLETE
Superseded by
FMS 17A5 or
17F38

(a) Durabla -
Durabla Manufacturing Co.
Paoli, PA 19301

FMS1-13/1

FC_01955

Form FC3083/Printed in USA

PLAINTIFF'S EXHIBIT 1008.1955

Fisher Controls	Material Specification	No. FMS 17A2 (D)
FISHER®	HIGH GRADE LONG FIBRE ASBESTOS SHEET GASKET MATERIAL	By CWW 8-7-73
		Apvd TKB 9-14-82
		Page 1 of 1
©Fisher Controls 1983		Rev MRP 9-7-83

E

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for elastomer bound asbestos gasketing and describes the composition of the approved source(s), their surface resistance, general usage, product name; and all approved substitutes for the approved sources.

2. MATERIAL REFERENCE NO. 0402

3. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% elastomeric binder.

4. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

5. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

6. MATERIAL SUBSTITUTION

The approved material(s) listed under FMS 17A4 may be substituted for the approved material(s) listed below. The substitution may be made provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS 17A2 material.

FMS 17A2 material may not be substituted for FMS 17A4 material.

7. APPROVED SOURCE(S)

FEB 22 1988

OBSOLETE
SUPERSEDED BY
FMS 17A3 OR 17F38

The following material(s) have been approved:

(a) Durabla -
Durabla Manufacturing Co.
Paoli, PA 19301

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD DRB APVD NFR
840, OLD STOCK
1 — USE
2 — REWORK
3 — SCRAP/REW
4 X SCRAP NOW
850, REASON
1 — SAFETY
2 — MATL
3 X IMPROVE
4 — ERROR
5 — STOCK
6 — COST
7 — MKTG/SALES
EFFECT
Make obsolete - no longer use asbestos

FC_01956

FMS1-13/1

Form FC0860/P/Printed in USA

PLAINTIFF'S EXHIBIT 1008.1956

Fisher Controls	Material Specification	No. FMS 17A2 © D
FISHER®	HIGH GRADE LONG FIBRE ASBESTOS SHEET GASKET MATERIAL	By CWW 8-7-73
		Apvd TKB 9-14-82
		Page 1 of 1
©Fisher Controls 1982, 1983		Rev CWW 9-14-82

1. SCOPE

This specification lists the approved source(s) for (nitrile) elastomer bound asbestos gasketing and describes the composition of the approved source(s), their surface resistance, general usage, product name; and all approved substitutes for the approved sources.

omit

2. MATERIAL REFERENCE No. 0402

3. (2.) MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% (nitrile type) elastomeric binder.

omit

4. (3) SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

5. (4) GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

6. (5) MATERIAL SUBSTITUTION

The approved material(s) listed under FMS17A4 may be substituted for the approved material(s) listed below. The substitution may be made provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

FMS17A2 material may not be substituted for FMS17A4 material.

7. (6) APPROVED SOURCES

SEP 13 1983

The following material(s) have been approved:

(a) Durabla -
Durabla Manufacturing Co.
(Wayne), PA (19087)
Paoli 19301

MAJOR REVISION — 9/12/83 DATE
BY NRP CHKD WHH APVD VFR
830. OLD STOCK 1 X USE 2 __ REMACHINE 3 __ SCRAP/NEW 4 __ SCRAP NOW
EXPLAIN
830. REASON 1 __ SAFETY 2 __ MATL 3 X IMPROVE 4 __ ERROR 5 X STDZN 6 __ COST

MATL. UPDATE

FC_01957

MC4432

Form FC3800/Printed in USA

PLAINTIFF'S EXHIBIT 1008, 1957

PENGAD 800-631-6989

The sheet is to be of best grade long fibre asbestos suitable for high pressure, high temperature service.

Material is to be an homogeneous construction.

The following commercial materials have been approved.

1. Durabla
2. Johns - Manville JM78 with JM Parting Agent

SEP 21 1982

DATE

MAJOR REVISION

BY CHKD NRP APVD TKB

840. OLD STOCK
1 USE
2 — REMACHINE
3 — [illegible]
4 — [illegible]

EXPLAIN

830. REASON
1 — SAFETY
2 — MATL
3 — IMPROVE
4 — ERROR
5 — STDZN
6 — COST
7 — FQ/ SALES

Completely rewritten to new format - removed Johns-Manville as approved source

FC_01958

High Grade Long Fibre Asbestos Sheet, Gasket Material		SIZE	TYPE
		DESIGN	
SUPERSEDED CP CWN 8-7-73	REVISIONS	FISHER Controls MARSHALLTOWN, IOWA CODE 22508	DWN. BY DATE
			CHKD.
			APVD.
			SCALE
		DWG. NO. FMS 17A2	REV. C (B)

Fisher Controls	Material Specification	No. FMS 17A3	E
FISHER®	ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES	By HW	5-20-53
		Apvd WFR	5-9-83
		Page 1 of 1	
©Fisher Controls 1983		Rev WHH	2-15-88

1. SCOPE

OBSOLETE

This specification lists the approved source(s) for compressed asbestos sheet material used for general purpose gasketing.

2. MATERIAL REFERENCE NO. - 0403

3. MATERIAL COMPOSITION & PROPERTIES

The sheet is to be of the best grade long fiber asbestos and SBR elastomeric binder. When clamped between flanges it must not stick to the flanges, even though they are primed or painted.

4. APROVED SOURCE(S)

(a) Garlock Mechanical Packing Division
Palmyra, N.Y.
Style No. 900/7735

(b) Nicolet Incorporated
Ambler, Pa.
Style No. 240

OBSOLETE
Superseded by
FMS 17A5 or
17F38

FMS2-I4/1

FC_01959

Form FC0883/Printed in USA

PLAINTIFF'S EXHIBIT 1008.1959

PENDAD 800-631-6989

Fisher Controls	Material Specification	No. FMS 17A3 (D)
FISHER	ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES	By HW 5-20-53
		Apvd NFR 9-9-83
		Page 1 of 1
©Fisher Controls 1983		Rev MRP 9-9-83

1. SCOPE

OBSOLETE

This specification lists the approved source(s) for compressed asbestos sheet material used for general purpose gasketing.

2. MATERIAL REFERENCE NO. - 0403

3. MATERIAL COMPOSITION & PROPERTIES

The sheet is to be of the best grade long fiber asbestos and SBR elastomeric binder. When clamped between flanges it must not stick to the flanges, even though they are primed or painted.

4. APROVED SOURCE(S)

(a) Garlock Mechanical Packing Division
Palmyra, N.Y.
Style No. 900/7735

(b) Nicolet Incorporated
Ambler, Pa.
Style No. 240

FEB 22 1988

OBSOLETE
superseded by
FMS 17A5 or
17F38

MAJOR REVISION
EOR/N NO. _____ DATE
BY WHN CHKD DRB APVD NFR
BAD, OLD STOCK
1 — USE
2 — REWORK
3 — SCRAP/REW
4 X SCRAP NOW
EXPLAIN
BSO; REASON
1 — SAFETY
2 — MATL
3 X IMPROVE
4 — ERROR
5 — STDZN
6 — COST
7 — MKTG/SALES

Make obsolete — no longer use asbestos

FMS2-14/1

FC_01960

Form FC3883/Printed In USA

PLAINTIFF'S EXHIBIT 1008.1966

ROA_03551

THE SHEET IS TO BE OF BEST GRADE LONG FIBRE ASBESTOS. WHEN CLAMPED BETWEEN FLANGES IT MUST NOT STICK TO THE FLANGES, EVEN THOUGH THEY ARE PRIMED OR PAINTED.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED.

1. GARLOCK STYLE NO. 900/7735
2. NICOLLET NO. 240

SEP 13 1983

MAJOR REVISION 9/9/83
BY NRP CHKD [illegible] APVD NFR DATE

840. OLD STOCK
1 X USE
2 REMACHINE
3 SCRAP/NEW
4 SCRAP NOW

830. REASON
1 SAFETY
2 MATL
3 X IMPROVE
4 ERROR

5 X CITIZEN
6 COST

MONTHLY REVIEW
PLACE IN NEW FORMAT
Completely retyped.

FC_01961

REVISIONS		
DATE	BY	CHKD.
4-18-79	[illegible]	ZIMZAK
10-16-79	MCB	[illegible]

TITLE ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES

	BY	DATE
DWN.	Hul.	5-20-53
TRCD.		
CHKD.		
APPR.		
SCALE		

FISHER GOVERNOR CO.
MARSHALLTOWN, IOWA

DESIGN NO.
DRAWER NO.
SUPERSEDES DWG. NO.

TYPE
SIZE
DWG. NO. FMS 1743
REV.

THE SHEET IS TO BE OF BEST GRADE LONG FIBRE ASBESTOS. WHEN CLAMPED BETWEEN FLANGES IT MUST NOT STICK TO THE FLANGES, EVEN THOUGH THEY ARE PRIMED OR PAINTED.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED.

1. GARLOCK STYLE NO. 7735

900/7735

MAJOR REVISION 10-22-79
BY MLB CHKD APVD
OLD STOCK
1 USE
2 REMACHINE
3 SCRAP/NEW
4 SCRAP NOW
EXPLAIN
REASON
1 SAFETY 5 STDZN
2 MATL 6 COST
3 IMPROVE
4 ERROR
UP-DATE APPROVED MATL
E. DIXSON

FC_01962

			TITLE ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES			TYPE	
				BY	DATE	DESIGN NO.	
			DWN.	RW	5-20-53		SIZE B
			TRCD.			DRAWER NO.	
DATE	BY	CHG.					DWG. NO. FMS17A3 (A)
REVISIONS			SCALE			SUPERSEDES DWG. NO.	

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

ROA_03553

Fisher Controls	Material Specification	No. FMS 17A4	C
FISHER	HEAVY DUTY ELASTOMER-BOUND ASBESTOS GASKET MATERIAL	By RGK	2-19-69
		Apvd TKR	9-14-82
		Page 1 of 1	
©Fisher Controls 1982		Rev WHH	2-15-88

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for nitrile elastomer bound asbestos gasketing and describes the composition of the approved source(s), their product name; and all approved substitutes for the approved source(s).

2. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% nitrile type elastomeric binder.

3. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

4. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

5. MATERIAL SUBSTITUTION

The approved source(s) may be substituted for the material source(s) shown on FMS17A2 provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

There is no approved substitute for FMS17A4 material.

6. APPROVED SOURCE(S)

The following material(s) have been approved:

OBSOLETE
Superseded by FMS 17A5 or 17F36

(a) Armstrong Accobest, AN-8012
(Cooper Manufacturing Co.)
Armstrong Industry Products Div.
Lancaster, PA 17604

FC_01963

PLAINTIFF'S EXHIBIT 1008.1963
PENGAD 800-631-6989

Fisher Controls	Material Specification	No. FMS 17A4 (B)
FISHER	HEAVY DUTY ELASTOMER-BOUND ASBESTOS GASKET MATERIAL	By RGK 2-19-69
		Apvd TKB 9-14-82
		Page 1 of 1
©Fisher Controls 1982		Rev LEW 9-14-82

C

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for nitrile elastomer bound asbestos gasketing and describes the composition of the approved source(s), their product name; and all approved substitutes for the approved source(s).

2. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% nitrile type elastomeric binder.

3. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

4. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

5. MATERIAL SUBSTITUTION

The approved source(s) may be substituted for the material source(s) shown on FMS17A2 provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

OBSOLETE
superseded by
FMS 17A5 or
17F38

There is no approved substitute for FMS17A4 material.

6. APPROVED SOURCE(S)

The following material(s) have been approved:

(a) Armstrong Accobest AN-8012
(Cooper Manufacturing Co.)
Armstrong Industry Products Div.
Lancaster, PA 17604

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD DRB APVD WFR
840, OLD STOCK
1 — USE
2 — REWORK
3 — SCRAP/REW
4 X SCRAP NOW
EXPLAIN
830, REASON
1 — SAFETY
2 — MATL
3 X IMPROVE
4 — ERROR
5 — STDZN
6 — COST
7 — MKTG/SALES

Make obsolete — no longer use asbestos

FEB 22 1988

FC_01964

MC4204
Form FC3683/Printed in USA

PLAINTIFF'S EXHIBIT 1668.1964
PENGAD 800-631-6989

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17A4 B (A)
	HEAVY DUTY (RUBBER) ASBESTOS GASKET MATERIAL Elastomer-Bound	ISSUED RGK 2-19-69
		REV.
		PAGE 1 OF 1

Heavy Duty Rubber-Asbestos

Nitrile - butadiene rubber binder

The following materials have been approved.

1) Armstrong Accobest AN-8012
   Cooper Manufacturing Company

SEP 21 1982
DATE

MAJOR REVISION
BY CHKD NRP APVD TKB

640. OLD STOCK
1 X USE
2 — REMACHINE
3 — SCRAP
4 — SALVAGE

830. REASON
1 — SAFETY 5 — STOCK
2 — MAT'L 6 — PART
3 X IMPROVE 7 — NEW
4 — SALVAGE 8 —

Completely rewritten to agree with new format.

FC_01965

FORMED PACKING TO BE MADE OF METAL PARTICLES, OIL-PROOF BINDER, LONG FIBRE ASBESTOS AND MUST BE SUITABLE FOR USE ON OILS AND PETROLEUM DISTILLATES AT TEMPERATURES UP TO 550°F.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. JOHN CRANE SUPER-SEAL NO. 3.

FC_01966

			TITLE: FORM PACKING-LONG FIBRE ASBESTOS, OIL-PROOF BOUND.			TYPE	
				BY	DATE	DESIGN NO.	
DATE	BY	CHKD.	DWN.	GRC	10-6-43		SIZE
REVISIONS			TRCD.			DRAWER NO.	
			CHKD.				DWG. NO.
SUPERSEDES DWG. NO. FMS3A1			APPR.			FILE NO.	FMS17D1
			SCALE				

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

PACKING SHALL BE MADE FROM LONG FIBRE ASBESTOS YARN BY THE BRAID OVER BRAID METHOD. PACKING IS TO BE LUBRICATED AND GRAPHITED. FINISHED PRODUCT SHALL BE RESISTANT TO STEAM, WEAK ACIDS, GAS, LYE AND CAUSTICS.

PACKING SHALL BE CUT FROM ROPE AND FORMED INTO RINGS OF THE OD, ID, AND LENGTH SPECIFIED.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. GARLOCK NO. 235 (RING FORM-CUT TO SIZE BY MFG'R).

FC_01967

			TITLE RING PACKING FOR STEAM, WEAK ACID, GAS, LYE OR CAUSTIC SODA.			TYPE	
				BY	DATE	DESIGN NO.	SIZE
DATE	BY	CHKD.	DWN.	GRJ.	10-6-43		
REVISIONS			TRCD.			DRAWER NO.	DWG. NO.
SUPERSEDES DWG. NO. FMS3AZ			CHKD.			FILE NO.	FMS17DZ
			APPR.				
			SCALE				

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

INACTIVE

Packing shall be made from high grade Canadian white asbestos. The string shall be formed by twisting together lubricated single strands of asbestos.

Diameter of the packing shall be specified by the Fisher Governor Company.

The packing shall be suitable for use with air, hot water and steam up to 800°F.

The following materials have been approved:

1. Palmetto String Packing - Greene, Tweed & Company

INACTIVE BY [illegible]

FC_01969

String Packing For Air, Hot Water & Steam

SIZE

TYPE

FISHER®
GOVERNOR CO.
MARSHALLTOWN, IOWA

	BY	DATE
DWN.	BRJ	10-6-43
CHKD.	[illegible]	6-22-59

FILE

SUPERSEDES

SCALE

DESIGN

DWG. NO. EMS17D4

REV. B

ROA_03559

INACTIVE

Packing shall be made from high grade Canadian white asbestos. The string shall be formed by twisting together lubricated single strands of asbestos.

Diameter of the packing shall be specified by the Fisher Governor Company.

The packing shall be suitable for use with air, hot water and steam up to 800°F.

The following materials have been approved:

1. Palmetto String Packing - Greene, Tweed & Company

MAJOR REVISION 3-2-61
BY LLW CHKD ZITZOW APVD
840. OLD STOCK ✓ 830. REASON
1 X USE
2 __ REMACHINE
3 __ SCRAP/NEW
4 __ SCRAP NOW
EXPLAIN ✓
1 __ SAFETY
2 __ MATL
3 X IMPROVE
4 __ ERROR
5 __ STOCK
6 __ COST
No Longer Available

INACTIVE BY

FC_01970

String Packing For Air, Hot Water & Steam				SIZE	TYPE	
FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA		BY	DATE	FILE	SUPERSEDES	DWG. NO. / REV.
	DWN	BRJ	10-6-43	SCALE	DESIGN	FMS17D4 8 (A)

ROA_03560

PACKING SHALL BE MADE FROM LONG FIBRE ASBESTOS YARN BY THE BRAID OVER BRAID METHOD. PACKING IS TO BE LUBRICATED AND GRAPHITED. FINISHED PRODUCT SHALL BE RESISTANT TO STEAM, WEAK ACIDS, GAS, LYE AND CAUSTICS.

PACKING SHALL BE FURNISHED IN ROPE FORM.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. GARLOCK NO. 233 (COIL FORM).

INACTIVE BY [illegible]

FC_01968

			TITLE: BRAIDED ROPE PACKING - FOR STEAM, WEAK ACID, GAS, LYE OR CAUSTIC SODA.			TYPE	
				BY	DATE	DESIGN NO.	
DATE	BY	CHKD.	DWN.	GRL	10-6-43		SIZE
REVISIONS			TRCD.			DRAWER NO.	
			CHKD.				DWG. NO.
SUPERSEDES DWG. NO. FMS 381			APPR.			FILE NO.	FMS17D3
			SCALE				

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

ALL DIMENSIONS ARE IN INCHES DO NOT SCALE THIS PRINT - WORK TO FIGURES

Fisher Controls	Material Specification	No. FMS 17D5	D
	GRAPHITED ASBESTOS PACKING	By GFB	9-7-49
FISHER®		Apvd TKB	1-25-83
		Page 1 of 1	
©Fisher Controls 1982, 1987		Rev WHH	4-15-87

OBSOLETE

1. SCOPE

This specification covers a graphited asbestos compound for use as valve stem packing.

2. MATERIAL REFERENCE NO. 0105

3. COMPOSITION

Molded or die formed ring packing made of asbestos fiber, graphite and treated with a surface lubricant in braided jacket over core construction.

4. APPROVED SOURCE

Argo Packing Co.
P.O. Box 66
Oakmont, PA. 15139
Style No. 500

OBSOLETE SUPERSEDED BY DWG. NO. FMS 17D28

FMS3-29/1

FC_01971

PLAINTIFF'S EXHIBIT 1008.1971

Fisher Controls | Material Specification | No. FMS 17F30 (5)

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

By DSG 12-11-72
Apvd BR 11-13-79
Page 1 of 2

©Fisher Controls 1984 1985 1986

Rev NRP 7-15-85

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS.

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION.

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS FC_02331

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
316L and asbestos, low chloride (9956)
321 and asbestos, low chloride (9971)
304 and asbestos, low chloride (9983)
delete
316L and composition, FMS 17N2 (992T)
321 and composition, FMS 17N2 (993T)
304 and composition, FMS 17N2 (993U)

JUL 1 1986

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

EXHIBIT 16 Duimstra 3-10-06

MAJOR REVISION

FMS1-15/1

DELETE ASBESTOS GASKET MATLS

ECR/N NO. _____ DATE 7-15-85
BY NRP CHKD WHH APVD NAR
840. OLD STOCK
1 X USE
2 __ REWORK
3 __ SCRAP/RETURN
1 __ SAMPLE
2 X REVISE
3 __ IMPROVE
5 __ STOCK
6 __ COST
7 __ ENTIRE

Form FC3911/Printed in U.S.A.

PLAINTIFF'S EXHIBIT 1008.2331

Fisher Controls	Material Specification	No. FMS 17F30 (H)
FISHER®	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIAL (CERTIFIED 200 PPM OR LESS)	By DSG 12-11-72
		Apvd BR 11-13-79
		Page 1 of
©Fisher Controls 1984		Rev NRP 2-2-84

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. MATERIALS APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
316L and asbestos, low chloride (9956)
321 and asbestos, low chloride (9971)
304 and asbestos, low chloride (9983)

Sources: Flexitallic Gasket Company or as specified on FMS 17N2

FMS1-15/1

316L and composition, FMS 17N2 (992T)
321 " " , FMS 17N2 (993T)
304 " " , FMS 17N2 (993U)

ECR/N NO. BY NRP CRVD: 840, OLD STOCK 1 X USE 2 — REWORK 3 — SCRAP/REW 4 — SCRAP NEW ADD NON-ASBESTOS SOURCES CORRECT VALVE APVD DATE JUL 25 1985 5 — STOCK 6 — CUST. 7 — RETRO/ SALES

FC_02332

Form FC3011/Printed in U.S.A.

PLAINTIFF'S EXHIBIT 1008 2332

Fisher Controls	Material Specification	No. FMS 1708	H
FISHER	TFE ASBESTOS - PACKING	By MMP	8-12-54
		Apvd TKB	2-18-82
		Page 1 of 1	
©Fisher Controls 1982, 1987		Rev WHH	4-15-87

OBSOLETE

1. SCOPE

This specification covers square braided asbestos valve stem packing impregnated with TFE (polytetrafluoroethylene).

2. MATERIAL REFERENCE NO. 0104

3. COMPOSITION

Square braided asbestos impregnated with TFE and furnished in ring form with bevel joint.

3.1 Packing should be reasonably clean and free from graphite. Not for oxygen service.

3.2 Note: For oxygen service specify FMS 17D11

4. APPROVED SOURCE

(a) Argo Packing Co.
P.O. Box 66
Oakmont, PA. 15139
Style No. 715

(b) Martin Merkel Packings and Seals, Inc.
5375 Naiman Parkway, Suite B
Cleveland, OH. 44139
Style No. 5741

OBSOLETE SUPERSEDED BY DWG. No. FMS 17D26

FMS3-27/1

FC_01972

PLAINTIFF'S EXHIBIT 1008.1972

ROA_03566

OBSOLETE

Fisher Controls	Material Specification	No. FMS 1709 C (B)
FISHER	HIGH TEMPERATURE ALUMINUM PACKING	By CMS 4-11-55
		Apvd NFR 4-11-86
		Page 1 of 1
©Fisher Controls 1986		Rev NRP 4-11-86

1. SCOPE

This specification covers valve stem packing compounds for use where packing temperatures are in excess of 450°F.

2. MATERIAL REFERENCE NOS.

0106 for Metallic Rings
011R for Plastic Rings

3. COMPOSITION

3.1 Metallic Rings: Lubricated aluminum foil twisted over a resilient fiberglass core.

3.2 Plastic Rings: A semi-metallic plastic packing of pure long synthetic fibers and aluminum shreds lubricated with graphite in a resilient binder.

3.3 No asbestos in any form shall be contained in either packing.

4. TEMPERATURE RANGE

+450°F to +900°F

5. PACKING CONFIGURATIONS

5.1 Metallic Rings: Use one at the bottom of the box and one at the top. If lantern ring is specified, use one at each side of lantern ring.

5.2 Plastic Rings: Use to fill space between metallic rings to give proper packing depth.

6. APPROVED SOURCE(S)

(a) Durametallic Corp.
2104 Factory St.
Kalamazoo, MI. 49001
Metallic Rings: Style D-110
Plastic Rings: Style D-222

MAJOR REVISION
ECR/N NO. _____ DATE DEC 9 1986
BY WHH CHKD JLG APVD NFR
840. OLD STOCK 850. REASON
1 X USE 1 — SAFETY 5 — STOCK
2 — REWORK 2 X PERF. 6 — COST
3 — SCRAP/REW 3 — IMPROVE 7 — MKTG/SALES
4 — SCRAP NOW 4 — ERROR
ENGINEER

MATERIAL NO LONGER AVAILABLE

OBSOLETE ; see none

FMS4-8/1

FC_01973

PLAINTIFF'S EXHIBIT 1008.1973

HIGH TEMPERATURE PACKING

Used where packing temperatures are in excess of 450° F.

Recommended for service to 900° F.

Packing shall consist of two types of rings.

Metallic Rings: Use one at the bottom of the box and one at the top. If lantern gland is furnished use one on each side of the lantern gland. Metallic rings shall consist of a high grade asbestos core about which treated, crinkled aluminum alloy foil sheets are twisted.

Plastic Rings: Use to fill space between metallic rings to give proper packing depth. Plastic rings shall consist of pure, long asbestos fibres and aluminum shreds lubricated.

The following materials have been approved:

Metallic Rings

Durametallic Style D-110 or D-10 (Alternate)

Plastic Rings

Durametallic Style D-222 or D-2 (Bulk alternate)

MAJOR REVISION 4-15-66
ECR/N No. _____ DATE
BY NEP WKH APVD NER
1 X
2 X
3
4
REFORMAT & ELIMINATE ASBESTOS

FC_01974

REVISIONS			TITLE High Temperature Packing			TYPE
DATE	BY	CHKD.		BY	DATE	
			DWN.	Conf	4-11-66	DESIGN NO.
			TRCD.			SIZE B
			CHKD.	WKH	4-11-66	DRAWER NO.
			APPR.			SUPERSEDES DWG. NO.
			SCALE			DWG. NO. FMS 1709

FISHER ® GOVERNOR CO. MARSHALLTOWN, IOWA

Fisher Controls | Material Specification | No. FMS 17F30 (5)

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

By DJG 12-11-72
Apvd BR 11-13-79
Page 1 of 2

©Fisher Controls 1984 1985 1986

Rev NRP 7-15-85

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS FC_02331

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets

316L and asbestos, low chloride (9956)
321 and asbestos, low chloride (9971)
304 and asbestos, low chloride (9983)
316L and composition, FMS 17N2 (992T)
321 and composition, FMS 17N2 (993T)
304 and composition, FMS 17N2 (993U)

delete

JUL 1 1986

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

MAJOR REVISION

EXHIBIT 16 Duimstra 3-10-06

FMS1-15/1

DELETE ASBESTOS GASKET MATLS

ECR/N NO. _____ DATE 7-15-85
BY NRP CHKD WHH APVD NAR
840. OLD STOCK 850. REVISION
1 X USE 1 ___ SCRAP 5 ___ STOCK
2 ___ REWORK 2 X REPAIR 6 ___ COST
3 ___ SCRAP/NEW 3 ___ IMPROVE 7 ___ OBSOLETE

Form FC3911/Printed in U.S.A.

PLAINTIFF'S EXHIBIT 1008.2331

Fisher Controls	Material Specification	No. FMS 17F30 (H)
FISHER®	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIAL (CERTIFIED 200 PPM OR LESS)	By DSG 12-11-72
		Apvd BR 11-13-79
		Page 1 of
©Fisher Controls 1984		Rev NRP 2-21-84

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. MATERIALS APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets — 316L and asbestos, low chloride (9956)
321 and asbestos, low chloride (9971)
304 and asbestos, low chloride (9983)

Sources: Flexitallic Gasket Company or as specified on FMS 17N2

FMS1-15/1

316L and composition, FMS 17N2 (992T)
321 " " , FMS 17N2 (993T)
304 " " , FMS 17N2 (993U)

ECR/N NO. BY NRP CSKD: WHH APVD DATE JUL 25 1985
NON-ASBESTOS SOURCES CORRECT MATRIX

FC_02332

Form FC3911/Printed in U.S.A.

PLAINTIFF'S EXHIBIT 1008 2332

Fisher Controls	Material Specification	No. FMS 17A4 (B)
FISHER	HEAVY DUTY ELASTOMER-BOUND ASBESTOS GASKET MATERIAL	By RGK 2-19-69
		Apvd TKB 9-14-82
		Page 1 of 1
©Fisher Controls 1982		Rev. LLHW 9-14-82

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for nitrile elastomer bound asbestos gasketing and describes the composition of the approved source(s), their product name; and all approved substitutes for the approved source(s).

2. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% nitrile type elastomeric binder.

3. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

4. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

5. MATERIAL SUBSTITUTION

The approved source(s) may be substituted for the material source(s) shown on FMS17A2 provided:

(a) The service conditions are acceptable to allow substitution.

(b). The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

OBSOLETE superseded by FMS 17A5 or 17F38

There is no approved substitute for FMS17A4 material.

6. APPROVED SOURCE(S)

The following material(s) have been approved:

(a) Armstrong Accobest AN-8012
(Cooper Manufacturing Co.)
Armstrong Industry Products Div.
Lancaster, PA 17604

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD DRB APVD HFR
840. OLD STOCK 830. REASON
1 — USE 1 — SAFETY 5 — STDZN
2 — REWORK 2 — MATL 6 — COST
3 — SCRAP/REW 3 X IMPROVE 7 — MKTG/SALES
4 X SCRAP NOW 4 — ERROR
EXPLAIN
Make obsolete — no longer use asbestos

FEB 22 1988

FC_01964

MC4204
Form FC3883/Printed in USA

PLAINTIFF'S EXHIBIT 1008.1964

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17A4 B (A)
	HEAVY DUTY ~~RUBBER~~ Elastomer-Bound ASBESTOS GASKET MATERIAL	ISSUED RGK 2-19-69
		REV.
		PAGE 1 OF 1

Heavy Duty Rubber-Asbestos

Nitrile - butadiene rubber binder

The following materials have been approved.

1) Armstrong Accobest AN-8012
Cooper Manufacturing Company

SEP 21 1982
DATE

MAJOR REVISION
BY [illegible] CHKD NRP APVD IKB

640. OLD STOCK
1 X USE
2 __ REMACHINE
3 __ SCRAP
4 __ [illegible]

EXPLAIN

830. REASON
1 __ SAFETY 5 __ STDZN
2 __ MATL 6 __ [illegible]ST
3 X Improve 7 __ [illegible]
4 __ [illegible] 8 __ [illegible]

Completely rewritten to agree with new format.

FC_01965

FORMED PACKING TO BE MADE OF METAL PARTICLES, OIL-PROOF BINDER, LONG FIBRE ASBESTOS AND MUST BE SUITABLE FOR USE ON OILS AND PETROLEUM DISTILLATES AT TEMPERATURES UP TO 550°F.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. JOHN CRANE SUPER-SEAL NO. 3.

FC_01966

			TITLE FORM PACKING-LONG FIBRE ASBESTOS, OIL-PROOF ROUND				TYPE	
				BY	DATE	FISHER GOVERNOR CO. MARSHALLTOWN, IOWA	DESIGN NO.	SIZE
DATE	BY	CHKD.	DWN.	GRC	10-6-43			
REVISIONS			TRCD.				DRAWER NO.	DWG. NO. FMS17D1
			CHKD.					
SUPERSEDES DWG. NO. FMS3A1			APPR.				FILE NO.	
			SCALE					

ROA_03574

PACKING SHALL BE MADE FROM LONG FIBRE ASBESTOS YARN BY THE BRAID OVER BRAID METHOD. PACKING IS TO BE LUBRICATED AND GRAPHITED. FINISHED PRODUCT SHALL BE RESISTANT TO STEAM, WEAK ACIDS, GAS, LYE AND CAUSTICS.

PACKING SHALL BE CUT FROM ROPE AND FORMED INTO RINGS OF THE OD, ID, AND LENGTH SPECIFIED.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. GARLOCK NO. 235 (RING FORM-CUT TO SIZE BY MFG'R).

FC_01967

			TITLE RING PACKING FOR STEAM, WEAK ACID, GAS, LYE OR CAUSTIC SODA.				TYPE	
				BY	DATE	FISHER GOVERNOR CO. MARSHALLTOWN, IOWA	DESIGN NO.	SIZE
DATE	BY	CHKD.	DWN.	GR	10-6-43		DRAWER NO.	
REVISIONS			TRCD.				FILE NO.	DWG. NO. FMS17DZ
SUPERSEDES DWG. NO. FM53AZ			CHKD.					
			APPR.					
			SCALE					

PACKING SHALL BE MADE FROM LONG FIBRE ASBESTOS YARN BY THE BRAID OVER BRAID METHOD. PACKING IS TO BE LUBRICATED AND GRAPHITED. FINISHED PRODUCT SHALL BE RESISTANT TO STEAM, WEAK ACIDS, GAS, LYE AND CAUSTICS.

PACKING SHALL BE FURNISHED IN ROPE FORM.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. GARLOCK NO. 233 (COIL FORM).

INACTIVE BY [illegible]

FC_01968

			TITLE BRAIDED ROPE PACKING – FOR STEAM, WEAK ACID, GAS, LYE OR CAUSTIC SODA.			TYPE	
				BY	DATE	DESIGN NO.	SIZE
DATE	BY	CHKD.	DWN.	GRI	10-6-43		
REVISIONS			TRCD.			DRAWER NO.	DWG. NO.
			CHKD.				
SUPERSEDES DWG. NO. FMS3B1			APPR.			FILE NO.	FMS17D3
			SCALE				

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

ALL DIMENSIONS ARE IN INCHES DO NOT SCALE THIS PRINT, WORK TO FIGURES

INACTIVE

Packing shall be made from high grade Canadian white asbestos. The string shall be formed by twisting together lubricated single strands of asbestos.

Diameter of the packing shall be specified by the Fisher Governor Company.

The packing shall be suitable for use with air, hot water and steam up to 800°F.

The following materials have been approved:

1. Palmetto String Packing - Greene, Tweed & Company

INACTIVE BY

FC_01969

String Packing For Air, Hot Water & Steam

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA		BY	DATE	FILE	SIZE
	DWN.	BRJ	10-6-43		TYPE
	CHKD.	[illegible]	6-22-59	SCALE	SUPERSEDES / DESIGN
					DWG. NO. FMS17D4
					REV. B

ROA_03577

INACTIVE

Packing shall be made from high grade Canadian white asbestos. The string shall be formed by twisting together lubricated single strands of asbestos.

Diameter of the packing shall be specified by the Fisher Governor Company.

The packing shall be suitable for use with air, hot water and steam up to 800°F.

The following materials have been approved:

1. Palmetto String Packing - Greene, Tweed & Company

MAJOR REVISION 3-2-61
BY [illegible] CHKD [illegible] APVD [illegible] DATE
840. OLD STOCK
1 X USE
2 __ REMACHINE
3 __ SCRAP/NEW
4 __ SCRAP NOW
EXPLAIN
830. REASON
1 __ SAFETY
2 __ MATL
3 X IMPROVE
4 __ ERROR
5 __ SIDZN
6 __ COST
No longer Available

INACTIVE BY [illegible]

FC_01970

String Packing For Air, Hot Water & Steam				SIZE	TYPE	
FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA	BY	DATE	FILE	SUPERSEDES	DWG. NO.	REV.
	DWN. BRJ	10-6-43	SCALE	DESIGN	FMS17D4	B-4

FISHER CONTROLS COMPANY

MARSHALLTOWN, IOWA 50158

AUTOMATIC CONTROL EQUIPMENT
SINCE 1880

July 11, 1980

University Hygienic Laboratory
Medical Laboratory Building
Iowa City, Iowa 52242

ATTN: Mr. I. A. Schwabbauer

Dear Ivan:

Enclosed are two gaskets for your use as "bulk" samples.

As I stated in our recent telephone conversation, I mailed four asbestos samples to you for analysis. Sample #3 was taken while flat black gaskets were being packed, and #4 while spiral wound (blue) gaskets were being packed. Both gasket types were being handled when samples #1 and #2 were taken.

The asbestos types used on these gaskets are probably chrysotile and crocidolite. More specific information on the asbestos types used is not readily available.

I also neglected to include an unused filter cassette with the samples I sent to you. A blank filter cassette has also been enclosed.

Thank you for your cooperation.

Sincerely,

FISHER CONTROLS COMPANY

Paul S. Adams

Paul Adams
Facilities & Equipment Engineering

PA/gf

Enclosures

Plaintiff's exhibit
1008.10670

calafish_10670

FISHER CONTROLS COMPANY

MARSHALLTOWN, IOWA 50158

AUTOMATIC CONTROL EQUIPMENT
SINCE 1940

July 9, 1980

University Hygienic Laboratory
Medical Laboratory Building
Iowa City, IA 52242

Attn: Mr. I.A. Schwabbauer

Dear Ivan:

Enclosed are four samples requiring analysis for asbestos. Accompanying these samples are copies of the Sampling Analysis Data Sheets for your reference.

The air volume drawn through each filter was as follows:

Sample No.	Air Volume (liters)
1	360
2	180
3	67
4	46

Please refer to Purchase Order No. L237473.

If you have any questions, please feel free to contact either myself or Chien Lin.

Sincerely,

FISHER CONTROLS COMPANY

Paul S Adams

Paul Adams
Equipment & Facilities Eng.

Enc.
PA/mz

cc: Chien Lin

Plaintiff's exhibit
LOCB-10665

calafish_10665

FISHER CONTROLS COMPANY

Sampling Analysis Data Sheet

1. Sample number: #1
2. Date taken: 6-16-80
3. Date submitted to lab: 7-9-80
4. By whom taken: PAUL ADAMS
5. Where taken: GAS REGULATOR AREA
6. Sampling for: ASBESTOS
7. Possible interference: CIGAR SMOKER
8. Analysis required:
9. Operator: [redacted]
10. Sampling pump number: 4515
11. Flow rate: 1500 cc/min.
12. Time in: 9:00 A.M.
13. Time out: 1:00 P.M.
14. Air volume: 360 LITERS
15. Remarks: A MAJORITY OF THE TIME WAS SPENT IN [illegible] WERE NOT HANDLED.

calafish_10666

FISHER CONTROLS COMPANY

Sampling Analysis Data Sheet

1. Sample number: #2
2. Date taken: 6-18-80
3. Date submitted to lab: 7-9-80
4. By whom taken: PAUL ADAMS
5. Where taken: E-BODY LINE, CENTER STREET PLANT
6. Sampling for: ASBESTOS
7. Possible interference: CIGARETTE SMOKE, ALIPHATIC HYDROCARBON PRESENT IN THE AREA.
8. Analysis required:
9. Operator: [redacted]
10. Sampling pump number: 4515
11. Flow rate: 1500 cc/min.
12. Time in: 9:37 am.
13. Time out: 11:37 pm.
14. Air volume: 180 LITERS
15. Remarks: MANY OF THE VALVES THE OPERATOR ASSEMBLED DID NOT CONTAIN ASBESTOS GASKETS. THE FOREMAN STATED THAT THE OPERATOR HANDLED AS MUCH AS ANYONE ON THE LINE.

calafish_10667

FISHER CONTROLS COMPANY

Sampling Analysis Data Sheet

1. Sample number: #3
2. Date taken: 7-7-80
3. Date submitted to lab: 7-9-80
4. By whom taken: PAUL ADAMS
5. Where taken: PACKAGING DEPT., CENTER STREET
6. Sampling for: ASBESTOS
7. Possible interference:
8. Analysis required:
9. Operator: [redacted]
10. Sampling pump number: 4514
11. Flow rate: 1500 cc/MIN.
12. Time in: 3:05
13. Time out: 3:50
14. Air volume: 67 LITERS
15. Remarks: ASBESTOS GASKETS WERE BEING WEIGH COUNTED [illegible] GASKETS WERE THE FLAT ASBESTOS - SHEET TYPE.

calafish_10668

FISHER CONTROLS COMPANY

Sampling Analysis Data Sheet

1. Sample number: #4
2. Date taken: 7-8-80
3. Date submitted to lab: 7-9-80
4. By whom taken: PAUL ADAMS
5. Where taken: PACKAGING DEPT., CENTER STREET
6. Sampling for: ASBESTOS
7. Possible interference:
8. Analysis required:
9. Operator: [redacted]
10. Sampling pump number: 4515
11. Flow rate: 1500 cc/MIN.
12. Time in: 1:58
13. Time out: 2:29
14. Air volume: 46 LITERS
15. Remarks: RUN TIME OF TEST INCLUDED A 10 MINUTE BREAK DURING WHICH THE OPERATOR STAYED AT HIS WORK STATION. ASBESTOS GASKETS SPIRAL-WOUND TYPE, WERE BEING PACKED INTO BLUE BOXES.

calafish_10669

The University of Iowa
Iowa City, Iowa 52242

University Hygienic Laboratory
(319) 353-6200



25 July 1980

Mr. Paul Adams
Facilities & Equipment Engineering
Fisher Controls Company
Marshalltown, IA 50158

Dear Paul:

We have analyzed the cassettes submitted for asbestos fiber counts. The results of the analysis are as follows:

Sample #	Air Volume	Fibers	Fields	Fibers/cc
1	360 l	49	100	0.48
2	180 l	0	100	0.00
3	67 l	1	100	0.05
4	46 l	0	100	0.00
Blank	0 l	0	100	0.00

If you have any questions on the analysis, please contact me.

I have instructed our business office to submit a bill for analytical services in the amount of $125.

Sincerely,

I. A. Schwabbauer
Chief, Occupational Health/Air Quality

mm

cc: J. Mefferd

calafish_10671

731038035 DLJ DLJ V#90520801 OT02 EU76 STK JLR/DBJ/
3 6.00

PCC1155 PCC1330 814.00

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER FILE

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. C32108-K2 **EDI**

ORDER DATE 9-03-92

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO: DUKE POWER CO.
OCONEE NUCLEAR STATION C32108-K2
C/O H.A. HEDDEN
HIGHWAY 183
SENECA, SC 29678

HEREIN DESIGNATED SELLER VIA UPS BROWN

TAX CERTIFICATE NUMBER: NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI ORDER ********** THIS ORDER HAS BEEN TRANSMITTED ELECTRONICALLY TO THE VENDOR. PLEASE SEND ORIGINAL COPY TO THE EDI COORDINATOR FOR VERIFICATION. **********		
1	1	EA	ASSEMBLY, , RELAY, MFR SPECIFIC INFO: HORIZONTAL MFR: FISHER CONTROLS CO. PART #: AJ6206000A2	115502121	126.00 EA
2	2	EA	GASKET, , TYPE: BELLOWS FRAME MFR: FISHER CONTROLS CO. PART #: 1D396803012	115502602	101.00 EA
3	1	EA		115502586	

(CONT. ON PAGE 2)

SHIPPING TERMS 0001

CASH TERMS NET 30 DAYS

PLAINTIFF'S EXHIBIT 1012-2

*NOTICE TO SELLER

ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents,
show ID numbers on boxes and invoices if shown on this order.
THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY PURCHASING DEPARTMENT PO BOX 1002 CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(803) 885-3551
(803) 885-3558

FILE COPY

REV. 06/91

		DATE	INVOICE AMOUNT
9/18/92 Acken s/g 2/3 wks	T10/20 Lt. S		

731038035 DLJ DLJ V#90520801 OT02 EU76 STK JLR/DBJ/
4 3.00 5 0.30 6 2.00
7 101.00

C1155 PCC1330

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. C32108-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC28 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			GASKET, MFR: FISHER CONTROLS CO. PART #: 1N4991-99202		
4	1	EA		115502605	
			ADAPTER, , CONNECTION: MALE MFR: FISHER CONTROLS CO. PART #: 1H784201012		
5	1	EA		115502621	
			ADAPTER, MFR: FISHER CONTROLS CO. PART #: 1H784401012		
6	5	EA		115502555	
			GASKET, , TYPE: SWITCH PLATE MFR: FISHER CONTROLS CO. PART #: 1N6741		
7	4	EA		115500395	

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. Freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

ADDRESS REPLY TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

FILE COPY

REV. 06/01

7310380.35 DLJ DLJ V#90520B01 0T02 EU76 STK JLR/DBJ/
8 3.00 9 6.00 10 0.45

CC1155 PCC1330

JKE POWER COMPANY
PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

C32108-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			GASKET, , TYPE: RELAY APPLICATION: FOR FISHER 3570 POSITIONER FURNISHED TO DP CO SPEC CNS-1205.06-3 MFR: FISHER CONTROLS CO. PART #: 1H855903012		
8	2	EA		115502617	
			SPRING, MFR: FISHER CONTROLS CO. PART #: 1H0917000A2		
9	9	EA		115000001	
			PIN, , TYPE: TRAVEL MFR: FISHER CONTROLS CO. PART #: 1U909646332		
10	2	EA		115502785	
			GASKET, , SIZE: 1/4" THK, MATERIAL: ASBESTOS APPLICATION: FOR FISHER CONTROL PRESSURE RELIEF VALVE MFR: FISHER CONTROLS CO.		

(CONT. ON PAGE 4)

SHIPPING TERMS	CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents. Show ID numbers on boxes and invoices if shown on this order.

THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: _____

FILE COPY

731077644
731077432 ENC ENC ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/

CC2444 PCC9370

UKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER FILE

2541:97

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

3-24-93

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

DUKE POWER CO.
OCONEE NUCLEAR STATION E14357-K2
C/O H.A. HEDDEN
HIGHWAY 183
SENECA, SC 29678

HEREIN DESIGNATED SELLER

VIA DELIVER

TAX CERTIFICATE NUMBER:
NC25 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER.

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI ORDER ********** THIS ORDER HAS BEEN TRANSMITTED ELECTRONICALLY TO THE VENDOR. PLEASE SEND ORIGINAL COPY TO THE EDI COORDINATOR FOR VERIFICATION. **********		
			PLEASE RUSH - ITEMS 1 AND 2 NEEDED FOR UPCOMING OUTAGE.		
1	1	EA	GASKET, , TYPE: BONNET APPLICATION: FOR FISHER GLOBE VALVE MODEL 475-DBQ 2.0 INCH MFR: FISHER GOVERNOR CO. PART #: 1L120899442	244401187	16.45 EA
2	5	EA	O-RING, MFR: FISHER CONTROLS CO. PART #: 1H849806992	254101840	.60 EA

(CONT. ON PAGE 2)

PLAINTIFF'S EXHIBIT 10/2-3

SHIPPING TERMS FOB: DEST

CASH NET 30 DAYS TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

5. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219
SENECA SC 29678

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(803) 885-3551
(803) 885-3558

FILE COPY

		DATE	INVOICE AMOUNT
6/3/93 Sch to ship wk of 7/8	7/19		

731077644
731077432

ENC ENC V#90520801 OT04 EU76 STK JLR/TLC/
ENC ENC

GO2444 PGC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SG1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
3	1	EA	ASSEMBLY, , SHAFT AND DISC, TYPE: BUTTERFLY VALVE APPLICATION: BUTTERFLY VALVE 8 INCH TYPE 9110 MFR: FISHER CONTROLS CO. PART #: H11780X0032	254102550	1,493.10 EA
4	2	EA	PACKING, RING, MATERIAL: TEFLON APPLICATION: FOR 24 INCH TYPE 7640 BUTTERFLY VALVE MFR: FISHER CONTROLS CO. PART #: G1860401302	254102508	25.20 EA
5	5	EA	PACKING, , MATERIAL: TEFLON APPLICATION: FOR VEE-BALL VALVE SIZE 6 INCH 657-8-U MFR: FISHER CONTROLS CO. PART #: 1R516001012	254202275	19.53 EA
6	1	EA		254200670	54.81 EA

(CONT. ON PAGE 3)

IPPING
RMS

CASH
TERMS

ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
Show ID numbers on boxes and invoices if shown on this order.

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

TWO COPIES OF INVOICE WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

ADDRESS REPLY TO:

ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219

FILE COPY

731077644
731077432

ENC ENC V090520B01 0T04 EU76 STK JLR/TLC/
ENC ENC

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
7	1	EA	SEAL, , TYPE: BALL APPLICATION: FOR 6 INCH TYPE 657-8-U CONTROL VALVE MFR: FISHER CONTROLS CO. PART #: 1R9703-36142 DWG #: CU5686	254200671	308.70 EA
8	2	ST	RING, BACK-UP APPLICATION: FOR FISHER 6 INCH BALL VALVE MFR: FISHER CONTROLS CO. PART #: 1P5698-36042 DWG #: CU5686	254600596	25.83 ST
9	3	EA	PACKING SET, APPLICATION: FOR FISHER VALVE 6 INCH TYPE EHT AND SIZE 16 INCH VALVE MFR: FISHER CONTROLS CO. PART #: 1R290801012	244400529	44.10 EA
			GASKET, FLANGED FITTING, TYPE: SPIRAL WOUND, MATERIAL: 316 SS WITH ASBESTOS, (CONT. ON PAGE 4)		

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219
SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

731077644
731077432

ENC
ENC

ENC
ENC

V$90520801 OT04

EU76 STK JLR/TLC/

CCQ444-PCG9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			SIZE: 1-13/16" ID X 1-15/16" OD X .175" THK APPLICATION: FOR GLOBE VALVE TYPE DBQ SIZE 1 INCH MFR: FISHER CONTROLS CO. PART #: 1N297999102		
0	2	EA		254101906	166.95 EA
			LINER, , TYPE: VALVE APPLICATION: FOR TYPE 9110 VALVE MFR: FISHER CONTROLS CO. PART #: F2622806782 DWG #: F11733 IT. 197 DELIVERY COMMITMENT: ITEMS 1 & 2 - STOCK PER S. MIRANDA ITEMS 3 & 4 - 2-3 WEEKS (04/15/93) BALANCE - 4-6 WEEKS (05/06/93) NEED DATE: ITEMS 1 & 2 - 03/31/93 BALANCE - ON OR BEFORE 05/30/93 PRICE AND DELIVERY PER PRICE LIST DATED 03/03/93. PRICED BY B. PARKER		

(CONT. ON PAGE 5)

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

ADDRESS REPLY TO:

5. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219

FILE COPY

731077644
731077432

ENC ENC V#90520001 0T04 EU76 STK JLR/TLC/
ENC ENC

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-18
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			03/22/93.		
			********** * * CONFIRMATION-DO NOT DUPLICATE (04) * * **********		
			PURCHASE ORDER NUMBER, ID NUMBER, AND PART(S) NUMBER (AS APPLICABLE) MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PART(S) TAGS, AND INVOICES. (05)		
			SHIPMENTS WILL BE ACCEPTED MONDAY THRU THURSDAY, 8:00 AM TILL 11:30 AM AND 12:30 PM TILL 4:30 PM, EXCEPT HOLIDAYS (INCLUDING EASTER MONDAY, DAY AFTER THANKSGIVING AND CHRISTMAS EVE). IN INSTANCES WHERE SHIPMENTS ARE NOT SO ENDORSED, ALL EXCESS CHARGES FOR DETENTION OR REDELIVERY WILL BE REBILLED TO THE SUPPLIER. (82)		
			********** * * PLEASE CONFIRM SHIP DATE UPON * * RECEIPT OF THIS ORDER *		
			(CONT. ON PAGE 6)		

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219

ADDRESS REPLY TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

FILE COPY

731077644
731077432

ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/
ENC ENC

302444-PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 58-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			* (4G) *		
			**********		

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

ADDRESS REPLY TO:

6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219

FILE COPY

731087587

ENC ENC V#90520801 OT02 EU76 STK JLR/TLC/

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

FILE

18617.30

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E21111-K2 **EDI**

ORDER DATE

5-19-93

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO: DUKE POWER CO.
OCONEE NUCLEAR STATION E21111-K2
C/O H.A. HEDDEN
HIGHWAY 183
SENECA, SC 29678

HEREIN DESIGNATED SELLER

VIA DELIVER

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI ORDER ********** THIS ORDER HAS BEEN TRANSMITTED ELECTRONICALLY TO THE VENDOR. PLEASE SEND ORIGINAL COPY TO THE EDI COORDINATOR FOR VERIFICATION. **********		
			ORDER PLACED BY PHONE, BILL PARKER TO S. MERANDA 05/18/93.		
1	1	EA	CAGE, VALVE, VALVE STYLE: GLOBE, VALVE SIZE: 16" APPLICATION: TYPE 476L-16-5-ENA "PISTON" MFR: FISHER CONTROLS CO. PART #: 4U7660X00A2	2444372756	12,070.80 EA
2	10	EA	PACKING, RING, MATERIAL: TEFLON APPLICATION: FOR 24 INCH BUTTERLFY VALVE	254102505	25.20 EA

(CONT. ON PAGE 2)

SHIPPING TERMS: FOB: DESTINATION

CASH NET 30 DAYS TERMS

ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents. Show ID numbers on boxes and invoices if shown on this order.

COPIES OF INVOICE, WITH FREIGHT BILL OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

ALL OCONEE NUCLEAR ... PURCHASING DEPARTMENT CORRESP... ICE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(803) 885-3551

PLAINTIFF'S EXHIBIT PCX-4

731087587 ENC ENC V#90520801 OT02 EU76 STK JLR/TLC/

02444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER: NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			TYPE 7640 MFR: FISHER CONTROLS CO. PART #: G1860301302		
3	1	EA	CAGE, VALVE, VALVE STYLE: DIAPHRAGM CONTROL, VALVE SIZE: 8" X 10" APPLICATION: FOR 8X10 INCH FISHER DIAPHRAGM CONTROL VALVE MFR: FISHER CONTROLS CO. PART #: 2U228233272	244404368	299.25 EA
4	14	EA	SEAL, , TYPE: SHIM APPLICATION: FOR 16 INCH FISHER V-BALL VALVE,TYPE U MFR: FISHER CONTROLS CO. PART #: 1R23764112	254200730	28.35 EA
5	2	EA	ASSEMBLY, , PLUG STEM, TYPE: GLOBE VALVE APPLICATION: FOR 3 INCH GLOBE VALVE PART NUMBER 11A5229X042 FISHER CONTROL (CONT. ON PAGE 3)	244406939	926.10 EA

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02C
PO BOX 1015
CHARLOTTE NC 28201-1015

ADDRESS REPLY TO:

6. ALL OCONEE NUCLEAR S... PURCHASING DEPARTMENT CORRESP... IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219
SENECA, SC 29679

FILE COPY

731087587 ENC ENC V#90520801 0T02 EU76 STK JLR/TLC/

GC2444-FCC9370-

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC25 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
6	1	EA	MFR: FISHER CONTROLS CO. PART #: 11A5229X042 SEAL, , TYPE: BALL APPLICATION: FOR FISHER CONTROLS BALL VALVE 16 INCH MFR: FISHER CONTROLS CO. PART #: 1V629805302	254200210	469.35 EA
7	6	ST	PACKING SET, APPLICATION: FOR BALL VALVE 16 INCH MFR: FISHER CONTROLS CO. PART #: 1R516201012	254201609	51.66 ST
8	6	EA	GASKET, FLANGED FITTING, TYPE: SPIRAL WOUND, MATERIAL: 316 SS WITH ASBESTOS, SIZE: 3-9/16" ID X 4-5/16" OD X .125" THK APPLICATION: FOR FISHER VEE-BALL VALVE U TYPE 10 INCH	254202253	9.14 EA

(CONT. ON PAGE 4)

SHIPPING TERMS	CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR S... PURCHASING DEPARTMENT CORRESP... CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 210
SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

REV. 6/80

731087587 ENC ENC V#90520801 OT02 EU76 STK JLR/TLC/

[illegible]444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020560

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
9	2	EA	MFR: FISHER CONTROLS CO. PART #: 1P927299102 ADAPTER, , TYPE: SEAT RING APPLICATION: FOR A 2 1/2" X 4" X 10" FISHER MODEL ES CONTROL VALVE SERIAL NUMBERS 4831796 & 4031797 MFR: FISHER CONTROLS CO. PART #: 1U2396X0022 DELIVERY COMMITMENT: ITEM 9 - BY 05/20/93 BALANCE - BY 07/01/93(PER S. MIRANDA) PRICE AND DELIVERY PER PRICE LIST DATED 03/03/93. DELIVERY REQUIRED: 7-01-93 PURCHASE ORDER NUMBER, ID NUMBER, AND PART(S) NUMBER (AS APPLICABLE) MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PART(S) TAGS, AND INVOICES. (05) (CONT. ON PAGE 5)	2546320575	1,456.00 EA

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.

TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

5. ALL OCONEE NUCLEAR [illegible] PURCHASING DEPARTMENT CORRESP[illegible]CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 219

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

731987587 ENC ENC V#90520801 OT02 EU76 STK JLR/TLC/

2444 PGC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			ALL INSIDE PACKAGING AND/OR PACKING MATERIAL MUST BE BIODEGRADABLE, I.E., NO PLASTICS OR STYROFOAM. (2F)		
			SHIPMENTS WILL BE ACCEPTED MONDAY THRU THURSDAY, 8:00 AM TILL 11:30 AM AND 12:30 PM TILL 4:30 PM, EXCEPT HOLIDAYS (INCLUDING EASTER MONDAY, DAY AFTER THANKSGIVING AND CHRISTMAS EVE). IN INSTANCES WHERE SHIPMENTS ARE NOT SO ENDORSED, ALL EXCESS CHARGES FOR DETENTION OR REDELIVERY WILL BE REBILLED TO THE SUPPLIER. (82)		
			********** * * * CONFIRMATION-DO NOT DUPLICATE (01) * * * **********		
			********** * * * PLEASE CONFIRM SHIP DATE UPON * * RECEIPT OF THIS ORDER * * (4G) * **********		

SHIPPING TERMS

CASH TERMS

NOT TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY, INVOICE OPERATIONS - PB02G, PO BOX 1015, CHARLOTTE NC 28201-1015
6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO: DUKE POWER COMPANY, OCONEE NUCLEAR STATION, PURCHASING DEPARTMENT, PO BOX 210, SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

383868 OCO REV. 8/92

ROA_03601

PS JS DHG V#90520801 0T00 CC EU STK EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

5-24-82

IMPORTANT

NO. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

CNS #001

D33-73307

H23395-73

CNS #002

FISHER CONTROLS COMPANY
% ROBERTTE MASON & CO
P O BOX 90424
CHARLOTTE N C 28233

MMIS

S DUKE POWER CO.
H C/O J. ED SMITH, MGR.,
O OCONEE NUCLEAR STATION
HIGHWAY 130
T P.O. BOX 1439
O SENECA, SC 29678
VIA UPS INSURED

HEREIN DESIGNATED SHIPPER

MAKE INVOICE TO:
X DUKE POWER CO.
MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION, AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED, THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
1	2	EA	DIAPHRAGM FOR FISHER CONTROLS DIAPHRAGM ACTUATOR MODEL 657 SIZE 45&50 CLASS B FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3 P.O. A-98519	25510087N	54.40 EA
2	2	EA	GASKET, CAGE 3 1/2 X 4 3/32 X 1/32 ASBESTOS SPEC FMS-17A2 P/N-1R384604022 FOR A FISHER 4 IN. GLOBE VALVE	244401862N	1.02 EA
3	2	EA	GASKET, BONNET 5 X 6 3/32 X 1/32 ASBESTOS SPEC. FMS-17A2 PART NO. 1R372404022 FOR A FISHER 4 IN GLOBE VALVE	244401863N	1.53 EA
4	2	EA	PIN, GROOVE TYPE C FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ED, GS&YD SIZE .75, 1, 2&3 INCH BODY SCREWED, SOCKET WELD&FLANGED RATING ANSI 600 CLASS B FURNISHED TO D.P.CO SPEC CNS-1205.06-3	243900042N	.31 EA
5	2	EA	STEM, PLUG FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ED, ES, ET, EAT&EWT SIZE 2.5, 3, 4, 6, 8, 6X10, 8X10, (CONT. ON PAGE 2)	244400460N	44.20 EA

QC ITEM NO. H23395-73.001 Fisher Controls Co DATE 10-82

SHIPPING TERMS FOB MARSHALLTOWN, IOWA

CASH TERMS NET 30 DAYS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:
MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 - TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO: E.A. LAIL

(704) 779

REV. 2/82

FILE COPY

PLAINTIFF'S EXHIBIT 10125-5

V#90520801 DTOO CC EU EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23995-79

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P.O BOX 39424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SHIPPER

VIA

MAKE INVOICE TO: DUKE POWER CO. / MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			10X16&14X16 INCH BODY BUTT WELD SCHEDULE 40&80&FLANGED RATING ANSI 600 CLASS F FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3		
6	2	EA	PLUG,VALVE FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ES SIZE 4&6 INCH BODY BUTT WELD SCHEDULE 40&FLANGED CLASS F FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3	244400463N	268.60 EA
7	2	EA	GASKET,SPIRAL WOUND 8 9/16 X 4 1/16 X 0. 175 INCONEL GRAPHITE PART NO. 1R384599442 FOR A FISHER 4 IN GLOBE VALVE	244401864N	18.36 EA
8	2	EA	GASKET,ADAPTOR 5 X 5 15/32 X 1/32 ASBESTOS SPEC. FMS-17A2 PART NO. 1J604704022 FOR A FISHER 4 IN GLOBE VALVE	244401865N	1.53 EA
9	2	EA	RING,SEAT FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ED,EDGET SIZE 2.5,4&6 INCH BODY BUTT WELD	244400489N	67.32 EA

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO: MILL-POWER SUPPLY CO. CHARLOTTE, N.C. 28232-2307 P.O. BOX 32307 TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO:

(704)

REV. 2/81

FILE COPY

V#90520801 0T00 CC EU EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SHIPPER | VIA

MAKE INVOICE TO: MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER

- DUKE POWER CO.
- MILL-POWER SUPPLY CO.

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			SCHEDULE 40&FLANGED DESIGN PRESSURE 360 PSIG DESIGN TEMPERATURE 300 DEGREES F. CLASS C FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3		
10	2	EA			
			GASKET,SEAT RING 3 1/2 X 3 29/32 X 1/32 ASBESTOS SPEC. FMS-17A2 P/N-1R884404022 FOR A FISHER 4 IN GLOBE VALVE	244401866N	.85 EA
11	2	EA			
			O-RING,7/8 X 1/8 X 1/8 NITRILE PART NUMBER 1B885506992 FOR A FISHER 4 IN GLOBE VALVE	244401867N	.31 EA
12	2	EA			
			PIN,GROOVE TYPE C FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ES,ET,EWD&U SIZE 2,4,6&8 INCH BODY FLANGED RATING ANSI 300 FURNISHED TO D. P.CO. SPEC. CNS-1205.06-3	243900044N	.31 EA
13	2	EA			
			O-RING,6 3/4 X 7 X 1/8 NITRILE PART NUMBER 1D547106992 FOR A FISHER 4 IN GLOBE VALVE	244401868N	3.40 EA

(CONT. ON PAGE 4)

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO: _____

(704) _____

REV. 2/82

FILE COPY

V#90520801 0T00 CC EU EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28238

SHIP TO

HEREIN DESIGNATED SHIPPER

VIA

MAKE INVOICE TO: DUKE POWER CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER* MILL-POWER SUPPLY CO.

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			THIS MATERIAL AND/OR SERVICE SHALL BE FURNISHED UNDER THE QUALITY ASSURANCE PROGRAM OF THE FISHER CONTROLS FACILITY AT GOVERNOR RD. & OLIVE STREET, MARSHALLTOWN, IOWA.		SPECIAL CLEANING, PACKAGING, AND DUKE FORM 930.1A - 79.40 EACH. DUKE FINAL INSPECTION IF REQUIRED - 25.00 EACH.
			PRICE AND DELIVERY PER YOUR QUOTATION DATED 5-17-82.		
			COMMITTED DELIVERY 8-27-82.		
			FORMS ATTACHED: QA-5058 7310620870.		
			DELIVERY REQUIRED: 9-01-82		
			ID NUMBER AND PURCHASE ORDER NUMBER MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PARTS TAGS, AND INVOICES. (05)		
			THE PROVISIONS OF TITLE 10, CODE OF FEDERAL REGULATIONS, PART 21 APPLY TO THIS PURCHASE. THE SIGNER OF THIS PURCHASE ORDER SHALL BE NOTIFIED IF THIS REGULATION IS INVOKED.		
			(CONT. ON PAGE 5)		

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side!
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2946

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO:

(704)

REV 2-02

FILE COPY

(0190Z057O CCT HCS AEB V#90520801 0T00 CC EU STK EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SHIPPER | VIA

MAKE INVOICE TO: . DUKE POWER CO. . MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER*

"BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED AT THE LOCATION, AT THE TIME OR TIMES, AND BY THE MEANS HEREIN SPECIFIED, THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			QUALITY ASSURANCE REQUIRED CONTROL LEVEL: 2 PROTECTION LEVEL: B CONDITION LEVEL: #		

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:
MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO:

(704)

REV. 2/82

FILE COPY

26050 (R12-81)

PREPARED BY S. Hall

DATE 4-23-82

DUKE POWER COMPANY
QUALITY ASSURANCE DEPARTMENT
FORM QA-506B

NUMBER 7310820570

PAGE 1 OF 1

QUALITY ASSURANCE REQUIREMENTS TO BE MET BY VENDORS OF ITEMS AND SERVICES

Items or services on this order must be manufactured or performed under a Duke-approved quality program. In accepting this order the designated vendor commits to the above as well as the performance and documentation of the tests or certifications checked below.

This documentation to be forwarded no later than date of shipment to: Quality Assurance Manager, Technical Services Duke Power Company Post Office Box 33189 Charlotte, North Carolina 28242

Line Item Number From Purchase Order	1. Cert. of Compliance	2. Functional Test	3. Phys. & Chem. Analy.	4. PT	5. MT	6. UT	7. RT	8. Hydro	9.	10.	11.	12. ANSI N45.2.1
1	X											
2	X											
3	X											
4	X											
5	X											
6	X											
7	X											
8	X											
9	X											
10	X											
11	X											
12	X											
13	X											

Detailed codes, standards and other requirements for tests, inspections or certifications

12. Clean items per ANSI N45.2.1-1973. Levels specified above.

IMPORTANT NOTICE TO VENDORS:

The documentation specified on this form constitutes an integral part of the purchase order requirements. Failure to supply it as specified will result in the items being quarantined upon receipt.

REMARKS:

*SUPPLY DOCUMENTATION IN ACCORD WITH DUKE SPEC. CNS 1205.06-3 LATEST REVISION.

The following documentation shall be forwarded as indicated above:

X 1. Results of all tests, inspections or certifications checked above.
X 2. Results of all tests, inspections or certifications required by referenced specifications.
X 3. Results of all tests, inspections or certifications required by referenced codes or standards.
X 4. Duke 930.1a Form
5. Duke 930.1c Form
6. _____

NOTIFICATION POINTS:

Vendor shall notify Duke QA Department at telephone number (704)373-4286 5 days prior to the following tests or inspections to allow in plant surveillance by Duke Personnel as deemed necessary:

1. None 2. Hydro Test X 3. Final Inspection
4. NDE: _____
5. Other: _____

PACKAGING AND SHIPPING REQUIREMENTS:

All items to be packaged and shipped per ANSI N45.2.2-1972

_____ Protection B

Rev. 8

FISHER SERVICE COMPANY - COLUMBIA, SOUTH CAROLINA

FISHER

Customer Order Number	Fisher/Agent Order Number	Invoice Date	Invoice Number
A06650-77	033 -804C98985	03/06/91	K022828

DUKE POWER COMPANY
P O BOX 1002
CHARLOTTE N.C. 28201

REMIT TO:
FISHER CONTROLS INTL INC
P.O. BOX 459F
ST. LOUIS, MO. 63150

PAGE 2

Ship To (Same as "Sold To" Unless Otherwise Indicated)
DUKE POWER CO/H B BARRON
OCONEE NUCLEAR STATION
7812 ROCHESTER HWY.
SENECA, SC. 19679

TERMS:
NET 030 DAYS IN U.S. FUNDS
F.O.B. COLUMBIA, SOUTH CAROLINA

Via UPS NEXT DAY AIR

Date Shipped		
Mo.	Day	Year
3	5	91

Item No.	Description	Quantity	Unit Price	Net Amount
00010	1P927299102 - GASKET,SPIRAL WOUND TAG: 254202253	3	9.45	28.35
00011	1B885506992 - O-RING TAG: 254202407	13	0.39	5.07
00012	1U222739102 - SEAT RING TAG: 254601358	3	385.00	1155.00
00013	24A1135X012 - SEAT RING TAG: 2546263121	2	770.00	1540.00
00014	38A1025X012 - CAGE,CAVITY,1 STAGE TAG: 2546263124	1	1582.00	1582.00
00015	OVERTIME CHARGE / WEEKEND WORK	1	750.00	750.00
00800	FREIGHT OUT - VIA	1	122.75	122.75
		RATE OK'd S.H.N.	SUBTOTAL	10491.74
			INVOICE TOTAL	10491.74

FISHER

DUKE POWER RECEIVED MAR 13 1991 INVOICE/ORDER EXT. PRICE

MAR 11 1991 MAIL DEPT. PURCHASING

PLAINTIFF'S EXHIBIT 10/2/92

...be allowed for material returned without our permission. This material was carefully packed and delivered to the transportation company in good condition. All claims for loss or damage in transit should be made to the transportation ...t once. Defect, replacement that the articles or services covered by this invoice were produced in compliance with the Fair Labor Standards Act of 1938, as amended. If items covered by this invoice are for ultimate export an export ...y be required.

COPY OF INVOICE

Form FS-7465

7310904483 WA JES V#90520801 0T50 EU76 STK JLR/GGC/P

CC2444. PCC9370.

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

A06650-77 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			*		
			**********		
			**********		
			*		
			* PLEASE CONFIRM SHIP DATE UPON *		
			* RECEIPT OF THIS ORDER *		
			* (4G) *		
			**********		

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
Show ID numbers on boxes and invoices if shown on this order.
FREE COPIES OF INVOICE, WITH FREIGHT BILL
OTHER SHIPPING DOCUMENTS ATTACHED.
ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

V. 09/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2298

FILE COPY

FISHER SERVICE COMPANY - COLUMBIA, SOUTH CAROLINA

FISHER

Customer Order Number	Fisher / Agent Order Number	Invoice Date	Invoice Number
A06650-77	033 -004C93985	03/06/91	K022828

DUKE POWER COMPANY
P O BOX 1002
CHARLOTTE N.C. 28201

REMIT TO:
FISHER CONTROLS INTL INC
P.O. BOX 459F
ST. LOUIS, MO. 63150

PAGE 1

Ship To (Same as Sold To Unless Otherwise Indicated)
DUKE POWER CO/H B BARRON
OCONEE NUCLEAR STATION
7812 ROCHESTER HWY
SENECA, SC 19679

TERMS:
NET 030 DAYS IN U.S. FUNDS
F.O.B. COLUMBIA, SOUTH CAROLINA

Date Shipped		
Mo.	Day	Year
3	5	91

Via UPS NEXT DAY AIR

Item No.	Description	Quantity	Unit Price	Net Amount
	JOB NO: T15811.			
0001	10A4223X012 - SEAL RING/SPR,RADIAL TAG: 244400452	2	80.50	161.00
0002	10A4225X012 - RING,RETAINING,EXT TAG: 244402414	1	25.20	25.20
0003	RPACKX00032 - KIT,REPAIR TAG: 244406359	3	29.40	88.20
0004	11A5229X042 - PLUG/STEM,HI-TEMP TAG: 244406939	2	980.00	1960.00
0005	28A1010X022 - PLUG/STEM,CAV III TAG: 2444261242	4	661.50	2646.00
0006	1H849806992 - O-RING TAG: 254101840	3	0.39	1.17
0007	01860301302 - PACKING,V-RING TAG: 254102505	12	26.60	319.20
0008	01860401902 - PACKING ADAPTOR,MALE TAG: 254102508	2	26.60	53.20
0009	1R516201012 - PACKING,SET TAG: 254201609	1	54.60	54.60

INVOICE CONTINUED

RECEIVED
MAR 11 1991
MAIL DEPT.
RECEIVING

will be allowed for material returned without our permission. This material was carefully packed and delivered to the transportation company in good condition. All claims for loss or damage in transit should be made to the transportation at once. Seller represents that the articles or services covered by this invoice were produced in compliance with the Fair Labor Standards Act of 1938, as amended. If items covered by this invoice are for ultimate export be export ay be required.

COPY OF INVOICE

Form PG 7165

7310904483 WA JES V#90520801 OT50 EU76 STK JLR/GGC/P

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

12424.99

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

A06650-77 **EDI**

ORDER DATE

2-28-91

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO: DUKE POWER CO.
C/O H.B. BARRON A06650-77
OCONEE NUCLEAR STATION
7812 ROCHESTER HIGHWAY
SENECA, S.C. 29678
P.O.BOX 1439, SENECA S.C. 29679

HEREIN DESIGNATED SELLER VIA YOUR TRUCK

TAX CERTIFICATE NUMBER: NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI PARALLEL TEST ORDER ********** THIS ORDER PRINTED FOR VERIFICATION PURPOSES ONLY. ********** PLEASE SEND ORIGINAL TO EDI COORDINATOR. **********		
			ORDER PLACED BY PHONE 2-27-91 B. PARKER TO A. STEHLEY		
1	2	EA	10A4223X012 RING, , TYPE: SPRING LOADED SEAL, APPLICATION: FOR GLOBE VALVE SIZE 4 INCH TYPE ET, 6 INCH TYPE EWT, 6 INCH X 10 INCH TYPE ET, 8 INCH TYPE EWT, 10 INCH X 16 INCH TYPE EWT, 14 INCH X 16 INCH TYPE EWT	24440452 RINGS	80.50 EA
			MANUFACTURER: FISHER PRODUCTS INC., PART NUMBER: 10A4223X012		

(CONT. ON PAGE 2)

SHIPPING TERMS: FOB JOBSITE

CASH TERMS: NET 30 DAYS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
2. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
3. Show ID numbers on boxes and invoices if shown on this order.
4. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY PURCHASING DEPARTMENT PO BOX 1002 CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(704) 373-6059

REV. 09/90

TELEX 57-2346 · TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2288

FILE COPY

		DATE	INVOICE AMOUNT
	RTL 3/6 3/7		

7310904483 WA JES V#90520801 DT50 EU76 STK JLR/GGC/P

PC2444 PC09370

UKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

A06650-77 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
2	1	EA	10A4225X012 RING, RETAINING, APPLICATION: FOR GLOBE VALVE SIZE 4 INCH TYPE ET, 6 INCH TYPE EWT, 6 INCH X 10 INCH TYPE ET AND EWT, 10 INCH X 16 INCH TYPE EWT, 14 INCH X 16 INCH TYPE EWT MANUFACTURER: FISHER PRODUCTS INC., PART NUMBER: 10A4225X012	244402414	25.20 EA
3	3	EA	RPACKX00032 KIT, , MODIFIER: REPAIR, TYPE: GLOBE VALVE, APPLICATION: FOR FISHER GLOBE VALVE TYPE 657-AR SIZE 3 INCH DESIGN PRESSURE 300 PSI DESIGN TEMPERATURE 300 DEGREES FAHRENHEIT SOCKET WELD AIR OPERATED CAST STEEL MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: RPACKX00032	244406359	29.40 EA
4	2	EA	11A5229X042 ASSEMBLY, , MODIFIER: PLUG STEM, TYPE: GLOBE VALVE, APPLICATION: FOR 3 INCH	244406939	980.00 EA

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents. Show ID numbers on boxes and invoices if shown on this order.

THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

ADDRESS REPLY TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

REV. 09/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2208

FILE COPY

7310904483 WA JES V#90520801 0T50 EU76 STK JLR/GGC/P

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

A06650-77 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIPTO

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER: NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			GLOBE VALVE PART NUMBER 11A5229X042 FISHER CONTROL		
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 11A5229X042		
5	4	EA	28A1010X022 STEM, , TYPE: FLOW CONTROL, SIZE: 4", APPLICATION: FOR FISHER VALVE 600 POUND WELD NECK SERIAL NUMBER 8980427	2444261242	661.00 EA
			MANUFACTURER: ROBERT E. MASON CO., PART NUMBER: 28A1010X022		
6	3	EA	1H849806992 O-RING,	254101840	.39 EA
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 1H849806992		
7	12	EA	G1860301302 PACKING, RING, MATERIAL: TEFLON, APPLICATION: FOR 24 INCH BUTTERLFY VALVE TYPE 7640.	254102505	260.60 EA

(CONT. ON PAGE 4)

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents. Show ID numbers on boxes and invoices if shown on this order.

FREE COPIES OF INVOICE, WITH FREIGHT BILL OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

ADDRESS REPLY TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

V. 09/80

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2298

FILE COPY

7310904483 WA JES V#90520B01 OT50 EU76 STK JLR/GGC/P

CC2444 PCC9370

UKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. A06650-77 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER: NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: G1860301302		
8	2	EA	G1860401302 PACKING, RING, MATERIAL: TEFLON, APPLICATION: FOR 24 INCH TYPE 7640 BUTTERFLY VALVE	254102508	26.60 EA
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: G1860401302		
9	1	ST	1R516201012 PACKING SET,, APPLICATION: FOR BALL VALVE 16 INCH MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 1R516201012	254201609	54.60 ST
10	3	EA	1P927299102 GASKET, FLANGED FITTING, TYPE: SPIRAL WOUND, MATERIAL: 316 SS WITH ASBESTOS, SIZE: 3-9/16" ID X 4-5/16" OD X .125" THK, APPLICATION: FOR FISHER VEE-BALL VALVE U TYPE 10 INCH	254202253	9.45 EA
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 1P92729910		

(CONT. ON PAGE 5)

SHIPPING TERMS.

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents. Show ID numbers on boxes and invoices if shown on this order.

THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: _____

REV. 05/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-8336
POWER GROUP (704) 382-2298

FILE COPY

ROA_03615

Fisher Controls | Material Specification | FMS 17D16

FISHER

SPECIFICATION FOR
LOW-CHLORIDE PACKING MATERIALS
CONFIDENTIAL

Rev: (7) U
By: DJG 12-11-72
Aprvd: TRB 10-16-81
Page 1 of 1

©Fisher Controls 1981, 1991

Revised By: WHH (8-23-91)
12-6-91

1. SCOPE

This specification establishes a procedure for purchasing, handling and assembling packing materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN'S are listed in parenthesis under Section 6.

3. CERTIFICATION BY VENDOR

Items purchased to this specification must be tested for leachable chloride per ASTM D512. Each order must be certified that the requirements have been met.

DEC 10 1991

4. PACKAGING BY VENDOR

Items must be packed in sealed plastic bags or envelopes which will prevent contamination and which are marked on the outside of the package to indicate that they have been specially processed. The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

Add new compound.

5. HANDLING AND ASSEMBLY

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

6. APPROVED MATERIALS

The following packing materials can be certified to contain 200 PPM or less leachable chlorides:

Materials

(a) Graphite Ribbon Die-formed (Grafoil GTA - UCAR Carbon Co.) (0199)

(b) Graphite Ribbon Die-formed with internal passivating inhibitor (Grafoil GTJ - UCAR Carbon Co.) (011W)

(c) Plastic, Molded PTFE FMS 17D7 (018R)

(d) Graphite Ribbon Die-formed with internal passivating inhibitor (Grafoil G-TI - UCAR Carbon Co.) certified for oxygen service per PGS BAII (011X)

Fisher Controls | Material Specification | FMS 17D18

SPECIFICATION FOR
LOW-CHLORIDE PACKING MATERIALS

FISHER

CONFIDENTIAL

Rev: (R) S
By: DJG 12-11-72
Apvd: TMB 10-16-01
Page 1 of 1

©Fisher Controls 1981, (1989) 1991

Revised By: (WHH 4-1-87)
WHH 1-8-91

1. SCOPE

This specification establishes a procedure for purchasing, handling and assembling packing materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN'S are listed in parenthesis under Section 6.

3. CERTIFICATION BY VENDOR

Items purchased to this specification must be tested for leachable chloride per ASTM D512. Each order must be certified that the requirements have been met.

4. PACKAGING BY VENDOR

Items must be packed in sealed plastic bags or envelopes which will prevent contamination and which are marked on the outside of the package to indicate that they have been specially processed. The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. HANDLING AND ASSEMBLY

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

6. APPROVED MATERIALS

The following packing materials can be certified to contain 200 PPM or less leachable chlorides:

Materials delete Die-formed

(a) Graphite (Molded) Ribbon (Grafoil GTA - Union Carbide) (0199)

(b) Plastic, Molded PTFE FMS 17D7 (0100M)

(c)

JAN 15 1991

(b) Graphite Ribbon Die-formed with internal passivating inhibitor (Grafoil GTI - Union Carbide) (011W)

MAJOR REVISION
ECN/R NO. _____ DATE
BY WHH CHKD DRS APVD MCR

Fisher Controls

Material Specification

FISHER

SPECIFICATION FOR
LOW-CHLORIDE PACKING MATERIALS

CONFIDENTIAL

No. FMS 17D16

By CLW 9-28-88

Appd [illegible] 9-29-88

Page 2 of 2

©Fisher Controls 1981, 1987

Rev 2.7 2-12-88

(a)
(c) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)
(d) Graphite Laminate FMS 17D15, Low Chloride FMS 17D16 (018H)
(e) Graphite Laminate/Zinc - High Density FMS 17D20 (019P)
(f) Graphite Laminate/Zinc - Medium Density FMS 17D23 (0191) — delete

(b) (g) Plastic, molded TFE FMS 1707 (018H)

JAN 05 1988

MAJOR REVISION

ECR/N NO. A9446 DATE

BY RJ7 CHKD WHH APVD NER

REASON: 1 X ECN; 2 ___ REDRAW; 3 ___ SCRAP/REW; 4 ___ SCRAP INCO; 5 ___ ECO, REVISION; 1 ___ CLARITY; 2 ___ MATL; 3 ___ IMPROVE; 4 ___ ERROR; 5 X STDZN; 6 ___ COST; 7 ___ MKTG/SALES

Deleted Graphite Laminate packings
Deleted page 2

©Fisher Controls 1981, 1986

(b)(c) Graphite Laminate - High Density FMS-17018 (019H)

(c)(d) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

(a)(e) Graphite Laminate FMS 17015, Low Chloride FMS 17016 (0188)

(e)(f) Graphite Laminate/Zinc - High Density FMS 17020 (019P)

(f)(g) Graphite Laminate/Zinc - Medium Density FMS 17023 (0191)

(h) Graphite Filament, Crane 1625-GF, low chloride (018H) - delete

(g)(i) Plastic, molded TFE FMS 1707 (018H)

MAJOR REVISION FEB 27 1987
DATE
KERR'N NO. ____ WHAT ____ NFR
BY RLT
340, 600 STOCK
1 X USE
2 __ REVISE
3 __ SCRAP/FILE
4 __ SCRAP ENTIRE

Delete Graphite Fil. Yarn, FMS 17019 (019G)
& Graphite Fil., Crane 1625-GF (018H)
Matl's, now covered by FMS 17019

Fisher Controls

FISHER

Material Specification

SPECIFICATION FOR
LOW-CHLORIDE PACKING MATERIALS

No.	FMS 17D16
By	LLW 9-23-80
Appd	ETER 9-26-80
Page	2 of 2
Rev	NRP 9-11-84

©Fisher Controls 1981, 1984

CONFIDENTIAL

(e) (7) Graphite Laminate - High Density FMS-17D18 (019H)

(d) (8) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

(e) (9) Graphite Laminate FMS 17D16, Low Chloride FMS 17D16 (018B)

(f) (10) Graphite Laminate/Zinc - High Density FMS 17D20 (019P)

(g) (11) Graphite Laminate/Zinc - Medium Density FMS 17D23 (0191)

(h) (12) Graphite Filament, Crane 1625-GF, low chloride (018H)

(i) Plastic, molded TFE FMS 1767 (018M)

JAN 21 1986

MAJOR REVISION

ECR/N NO. _____ DATE>

BY NRP CHKD WHH APVD MPR

R&D, OLD STOCK
1 ☒ USE
2 — REWORK
3 — SCRAP/NEW
4 — SCRAP NOW

EXPLAIN

R&D, REASON
1 — SAFETY
2 ☒ MAIN
3 — IMPROVE
4 — ERROR
5 — STDTR
6 — COST
7 — MKTG/SALES

ELIMINATE MATERIALS CONTAINING

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SPECIFICATION FOR
LOW-CHLORIDE PACKING MATERIALS

VS. FMS 17D16 (L)
DES'D [illegible] 9-23-80
APVD [illegible] 9-26-80
PAGE 2 OF 2
REV [illegible] 11-9-82

CONFIDENTIAL

(7) Graphite Laminate - High Density FMS-17D18 (019H)

(8) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

(9) Graphite Laminate FMS 17D15, Low Chloride FMS 17D16 (018B)

(10) Graphite Laminate/Zinc - High Density FMS 17D20 (019F)

(11) Graphite Laminate/Zinc - Medium Density FMS 17D23 (0191)

(12) Graphite Filament, Crane [illegible], low chloride (018N)

9/20/84
DATE
MAJOR REVISION
BY WRP CHKD [illegible] APVD [illegible]
ADD CRANE MATL & CHANGE FORMAT

© FISHER CONTROLS, 1981 (1992) 1984

FISHER Control
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SPECIFICATION FOR
LOW-CHLORIDE PACKING MATERIALS

NO. FMS 17D15 (B)
BY [illegible] 9-23-82
APVD [illegible]
PAGE 2 OF 2
REV [illegible]

CONFIDENTIAL

(7) Graphite Laminate - High Density FMS-17D18 (019H)

(8) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

(9) Graphite Laminate FMS 17D15, Low Chloride FMS 17D16 (018B)

(10) Graphite Laminate/Zinc - High Density FMS 17D20 (019T)

(11) Graphite Laminate/Zinc - Medium Density FMS 17D21 (019U)

NOV 17 1982

MAJOR REVISION DATE
BY: [illegible] CHKD [illegible] APVD [illegible]

DISP. OLD STOCK		RSN. REASON	
1 X-USE	DISP	1 — SAFETY	5 — STOCK
2 — REMACHINE		2 — MAINT.	6 — COST
3 — SCRAP/REWD		3 X IMPROVE	7 — MKTG/SALES
4 — SCRAP NOW		4 X ERROR	

Corrected error in mtl. ref. no. for FMS 17D23

© FISHER CONTROLS, 1981, 1982

FISCHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SPECIFICATION
FOR LOW-CHLORIDE PACKING MATERIALS

REV. FMS 17D16 C
BY [illegible] 9-21
APVD [illegible]
PAGE 2 OF 2
REV [illegible] 9-21

CONFIDENTIAL

Materials Contained:

(10) Graphite Laminate/Zinc - High Density FMS 17D20 (019F)

(11) Graphite Laminate/Zinc - Medium Density FMS 17D23 (019U)

OCT 21 1981
DATE

MAJOR REVISION
BY [illegible] CHKD [illegible] APVD TKB

EXPLAIN:
NEW, OLD STOCK
1 — USE
2 — REMACHINE
3 — SCRAP/NEW
4 — SCRAP NOW

REASON
1 — SAFETY
2 — MAIL
3 — IMPROVE
4 — ERROR
5 — STOCK
6 — COST

Change on page 1

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SPECIFICATION
FOR LOW-CHLORIDE PACKING MATERIALS

NO. FMS 17D16 J-H
ISSUED 12/11/72 DJW
REV. JHS 1-30-73
PAGE 1 OF 4

CONFIDENTIAL

1. Scope

This specification establishes a procedure for purchasing, handling and assembling packing materials, which must not contain more than 200 parts per million leachable chlorides.

2. Purpose of Requirement

Presumably the chloride content must be as low as practicable in components because of the danger of stress corrosion in stainless steel in the system.

3. Certification By Vender

Items purchased to this specification must be tested for leachable chloride per ASTM D512-67. The items must also be manufactured, processed and packaged in a manner which will justify certification.
Each order must be certified that the requirements have been met.

4. Packaging By Vender

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

MAJOR REVISION
BY JHS CHKD PJH APVD
B40. OLD STOCK
B30. REASON
EXPLAIN
1 — USE
2 — REMACHINE
3 — SCRAP/ACW
4 — SCRAP NOW
1 — SAFETY
2 — MATL
3 X IMPROVE
4 — ERROR
5 — SIGN
6 — COST
Add FMS 17D28 → 17D13
to Materials

5. Handling and Assembly By Fisher

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

6. Materials

The following packing materials can be certified to contain 200 PPM or less leachable chlorides:

Materials

(1) ASB-Inconel-Graphite, Crane 187-I, Low Chloride (0186)

(2) ASB-Graphite, Crane 187-J, Low Chloride (0187)

(3) ASB-TFE, Crane C-994, Low Chloride (0188)

(4) ASB-Inconel-Graphite, Crane 177A1, Low Chloride (0189)

(5) Graphite Filament Yarn, FMS 17D19
Low Chloride (0190)

(6) Graphite Laminate/Zinc, FMS 17D17 (019A)

(7) Graphite Laminate - High Density FMS-17D18 (019H)

(8) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

(9) Graphite Laminate FMS 17015, Low Chloride FMS 17D1[illegible]

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SPECIFICATION
FOR LOW-CHLORIDE PACKING MATERIALS

FMS 17D16 F
ISSUED 12/11/72 DJS
REV. WOH 3-24-77
PAGE 1 OF 1

CONFIDENTIAL G

1. Scope

This specification establishes a procedure for purchasing, handling and assembling packing materials, ~~which must not contain more than~~ 200 parts per million leachable chlorides at 1000 °F.

2. Purpose of Requirement

Presumably the chloride content must be as low as practicable in components because of the danger of stress corrosion in stainless steel in the system.

3. Certification By Vender

Items purchased to this specification must be manufactured, processed and packaged in a manner which will justify certification by the supplier.

Each order must be certified that the requirements have been met.

4. Packaging By Vender

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

5. Handling and Assembly By Fisher

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

6. Materials

The following packing materials can be certified to contain 200 PPM or less leachable chlorides at 1000 °F.

Materials

(1) ASB-Inconel-Graphite, Crane 187-I, Low Chloride (0188)

(2) ASB-Graphite, Crane 107-J, Low Chloride (0187)

(3) ASB-TFE, Crane C-994, Low Chloride (0188)

(4) ASB-Inconel-Graphite, Crane 177AL, Low Chloride (0189)

(5) Graphite Filament Yarn, FMS 17D19
Low Chloride (0190)

(6) Graphite Laminate/Zinc, FMS 17D17 (019A)

(7) Graphite Laminate - High Density FMS-17D18 (019H)

(8) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

(9) Graphite Laminate FMS 17D15, Low Chloride FMS 17D1

10-2-77
FOR REVISION
CHKD. APVD. DATE
REQ. REASON
STOCK
USE
ENGINEERING
PURCHASING
SHOP NOW
SAFETY
MAIL
IMPROVE
ERROR
Clarification

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03625

	MATERIAL SPECIFICATION	NO. FMS 17D16
FISHER Controls MARSHALLTOWN, IOWA	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE PACKING MATERIALS	ISSUED 12/11/73 REV. 12-13-73 PAGE 1 OF 1

CONFIDENTIAL

1. Scope

This specification establishes a procedure for purchasing, handling and assembling packing materials, which must not contain more than 200 parts per million leachable chlorides.

2. Purpose of Requirement

Presumably the chloride content must be as low as practicable in components because of the danger of stress corrosion in stainless steel in the system.

3. Certification

Items purchased to this specification must be manufactured, processed and packaged in a manner which will justify certification by the supplier.

Each order must be certified that the requirements have been met.

4. Packaging

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. Assembly

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. Materials

The following packing materials can be certified to contain 200 PPM or less leachable chloridest

Materials

(1) ASB-Inconel-Graphite, Crane 187-I, Low Chloride (0186)

(2) ASB-Graphite, Crane 187-J, Low Chloride (0187)

(3) ASB-TFE, Crane C-994, Low Chloride (0188)

(4) ASB-Inconel-Graphite, Crane 177A1, Low Chloride (0189) FMS 17D19 -ADD

(5) Graphite Filament Yarn, Crane 1625-CF, Low Chloride OR Chempro X099 Low Chloride (0190) OMIT

(6) Graphite Laminate/Zinc, FMS 17D17 (0194) -HIGH DENSITY -ADD

(7) GRAPHITE LAMINATE FMS-17D18 (0198) -ADD

(8) (7) Graphite Molded Ribbon (Grafoil - Union Carbide) (0199)

ENGINEERING DEPT. APPROVAL BY MAJOR REVISION DISPOSITION OF OLD STOCK - USE AVAILABLE SUPPLIES FOR LAMINATED PKG. WITHOUT ZINC RING

Fisher Controls

FISHER

GRAPHITE LAMINATE (PACKING) CONFIDENTIAL

By RKB	4-3-89
Appd RKB	4-5-89
Page 1 of 1	
Rev NRP	10-25-95

©Fisher Controls 1982, 1985

OBSOLETE

1. SCOPE

This specification covers laminated graphite materials used for high temperature valve stem packing applications.

2. MATERIAL REFERENCE NO. 0165 (standard)

0188 for less than 200 ppm leachable chloride - per FMS 17D16

3. COMPOSITION

(a) All graphite composition

(b) Density 70 lbs./cu. ft.

(c) Laminations perpendicular to shaft

OBSOLETE
SUPERSEDED BY
FMS 17D17
MRN 0165

4. APPROVED SOURCE(S)

(a) Union Carbide Corporation
Carbon Products Div.
Trade Name - Grafoil

MAJOR REVISION JAN 05 1988

SCR/R NO. A9440 DATE

BY RJT CHKD WHH APVD NRP

0 BAD OLD ERROR		4 BAD READING	
1 X USE	NEW	1 SAFETY	5 STOCK
2 REWORK		2 WEAR	6 COST
3 SCRAP/USE	OLD	3 X IMPROVE	7 MFRS/SALES
4 SCRAP NOW		4 ERROR	

Obsolete

FISHER ® GOVERNOR CO. MARSHALLTOWN, IOWA U.S.A.

MATERIAL SPECIFICATION

FMS 17D15 (U)

GRAPHITE LAMINATE (PACKING)

ISSUED RKB 4-8-6

REV.

PAGE 1 OF 1

CONFIDENTIAL

All Graphite Packing

Density 70 lb/cu ft

Laminations Perpendicular to Shaft

Approved Source

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil
Catalog No. GS300

1. SCOPE

This specification covers laminated graphite materials used for high temperature valve stem packing applications.

2. MATERIAL REFERENCED NO. 6165

3. COMPOSITION

(a) All graphite composition
(b) Density 70 lb./cu. ft.
(c) Laminations perpendicular to shaft

4. APPROVED SOURCE (S)

(a) Union Carbide Corporation
Carbon Products Div.
Trade Name - Grafoil

APR 14 1982

1-5-84
DATE

MAJOR REVISION
BY [illegible] APVD. RKB

B40. OLD STOCK
1 — OBSOLESCENCE
2 — REQUIRE SPEC REVISION
3 — SPEC REVISION
4 — SCRAP NOW

B90. REASON
1 — SAFETY
2 — MATH
3 — CARRYOVER
4 — ERROR

5 — STATUS
6 — COST
7 — SPECIFICATION

Update to new format

© Fisher Controls 1982.

Fisher Controls | Material Specification | FMS 17D14

GLASS FILLED PTFE PACKING

Rev: F G—
By: LLB 3-11-66
Apvd: TKB 1-25-82
Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls 1982, 1990 1991

Revised By: WHH. 1-28-90
12-13-91

1. SCOPE

This specification covers glass filled PTFE compounds used as V-ring type valve stem packing and piston rings, valve discs, ball seals and gaskets.

2. MATERIAL REFERENCE NOS.

0120 - Standard
0199 - Special - yellow color
0117 - Special - green color

3. COMPOSITION

V-Ring Packing Compound of virgin PTFE (polytetrafluoroethylene) filled with 15 to 25 weight percent glass fibers and inorganic coloring.

4. TEMPERATURE RANGE

0°F TO +450°F

5. APPROVED SOURCE(S)

(a) John Crane International
Morton Grove, IL
Style No. 74-86 (251)

(b) United Polymer, Inc.
Houston, TX
Style No. Fluorogreen E110

JAN 2 0 1992

MAJOR REVISION

ECR/N NO. _____ DATE 1/92

BY WHH CHKD KRB APVD MRB

REASON: 840. OLD STOCK; 1 USE; 2 REWORK; 3 SCRAP/REWORK; 4 SCRAP NOW; CODE: 1 SAFETY, 2 MAIL, 3 IMPROVE, 4 ERROR, 5 STOCK, 6 COST, 7 MKTG/SALES

Add other applications since these MEN's are also used for parts other than packing.

TAYLOR V. 3.M. COMPANY ET AL.

Fisher Controls	Material Specification	No. FMS 17014	
FISHER	GLASS FILLED PTFE PACKING CONFIDENTIAL	By LLB	3-11-66
		Appd TKB	1-25-82
		Page 1 of 1	
©Fisher Controls 1982, (1987) 1989		Rev WHH	4-15-87

1. SCOPE

This specification covers glass filled PTFE compounds used as V-ring type valve stem packing and piston rings.

2. MATERIAL REFERENCE NOS 0120 (standard)
0120 - standard
019W special - yellow color
0117 special - green color

3. COMPOSITION

V-ring packing compound of PTFE (polytetrafluoroethylene) filled with 15 to 25 weight percent glass fibers and inorganic coloring.

4. TEMPERATURE RANGE

0° F to + 450° F

5. APPROVED SOURCE(S)

(a) Crane Packing Co.,
Morton Grove, IL.
Style No. 74-06 (25%)

(b) United Polymer, Inc.
Houston, TX
Style No. Fluoregreen E110

MAJOR REVISION
ECN/N NO. _____ DATE JUN 15 1989
BY WHH CHKD DCB APVD NFR
ENGR. REVISION: 1 SAFETY, 2 STATIC, 3 IMPROVE, 4 ERROR, 5 STORE, 6 COST, 7 MKTG/SALES
Add source and special MPN for green colored parts.

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GLASS FILLED TFE PACKING

NO. FMS 17014 (6)
BY [illegible] 3-11-86
APVD TKS 1-27-86
PAGE 1 OF 1
DEV [illegible] 1-20-86

CONFIDENTIAL

1. SCOPE

This specification covers glass filled TFE compounds used as V-ring type valve stem packing and piston rings.

2. MATERIAL REFERENCE NO. 0120 (standard)

019W special - yellow color

3. COMPOSITION

V-ring packing compound of TFE resin (polytetrafluoroethylene) filled with 15 to 25 weight percent glass fibers.

4. APPROVED SOURCE

Crane Packing Co.
Morton Grove, IL.
Style No. 74-06 (25%)

OCT 30 1985

MAJOR REVISION
ECR/N NO. N/A DATE
BY NRP CHKD [illegible] APVD [illegible]
840. OLD $ STOCK
X 1 USE
2 — REWORK
3 — SCRAP/USE
4 — SCRAP NOW
830. REASON
EXPLAIN 1 — SAFETY 5 — STRENGTH
2 — MATL 6 — COST
3 — IMPROVE 7 — MATCH/SALES
4 — ERROR

© FISHER CONTROLS, 1982

ADD MAT'L REF. NO. 1 TO PART NO. NEW FORMAT

Fisher Controls | Material Specification | FMS 17D13

LOW PROFILE PTFE PACKING | Rev: 6 | By: ELB 3-11-66 | Apvd: TKB 1-25-82 | Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls 1982, 1991 | Revised By: WHH 12-13-91

1. SCOPE

This specification covers virgin PTFE, low profile, V-ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS.

(a) 0119

(b) 0176 for oxygen service clean and handle per PGS GA11

3. COMPOSITION

Molded, coined, or machined virgin PTFE ((polytetrafluoroethylene) in a low profile V-ring configuration.

4. TEMPERATURE RANGE

-40°F to +450°F

5. APPROVED SOURCE(S)

(a) John Crane International
Morton Grove, IL
Style No. 774 (machined)
or Style No. 775 (memorized or coined)

(b) Garlock, Plastics Div.
Camden, NJ
"Molded PTFE V Packing"

(c) Norton Performance Plastics
Elk Grove, IL
Style No. 600

MAJOR REVISION 5-27-97
ECRN No. 9101398 Date
By HH Chkd PMD Apvd JAG
AUG 5 - 1997
Old Stock: 1 USE 2 REWORK 3 SCRAP/NEW 4 SCRAP NOW
Explain: 1 SAFETY 2 MATL 3 IMPROVE 4 ERROR
Reason: 5 STD/N 6 COST 7 MKTG/SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | FMS 17013 (D)

FISHER

LOW PROFILE PTFE V-RING PACKING CONFIDENTIAL

By L.L.B 3-11-66
Appd CRS 1-26-82
Page 1 of 1

©Fisher Controls 1982, 1987 1990

Rev WHH (1-15-87) 11-28-90

1. SCOPE

This specification covers virgin PTFE, low profile, V-ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS.

(a) 0119

(b) 0176 for oxygen service clean and handle per FGS 8A11.

3. COMPOSITION

Molded, coined, or machined virgin PTFE (polytetrafluoroethylene) in a low profile V-ring configuration.

4. TEMPERATURE RANGE

-40° F to + 450° F

6. APPROVED SOURCES

(a) (Crane Packing Co.) John Crane International
Morton Grove, IL.
Style No. 774 (machined)
or Style No. 775 (Memorized or coined)

(b) Garlock Plastics Div.
Camden, N.J.
"Molded PTFE V Packing"

(c) (Halogen Insulator & Seal Co.) Norton Performance Plastics
Elk Grove, IL.
Style No. 600

DEC 14 1990

MAJOR REVISION

ECR/K NO. _____ DATE

BY WHH CHKD RJF APVD NPS

Update names of vendors.

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03633

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

LOW PROFILE TFE V-RING PACKING

XO. FMS 17013 (B)
BY GFD 8-11-66
APVD TKB 1-25-82
PAGE 1 OF 1
REV S.FA 1-20-82

CONFIDENTIAL NRP 4-17-85

1. SCOPE

This specification covers virgin TFE, low profile, V-ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS (0119) — delete

(a) 0119

(b) 0176 for oxygen service. Clean and handle per FGS 8A11.

3. COMPOSITION

Molded, coined, or machined virgin TFE (polytetrafluoroethylene) in a low profile V-ring configuration.

4. APPROVED SOURCES

(a) Crane Packing Co.
Morton Grove, IL
Style No. 774 (machined)
or Style No. 775 (memorized or coined)

(b) Garlock Plastics Div.
Camden, N.J.
"Molded TFE V Packing"

(c) Halogen Insulator & Seal Co.
Elk Grove, IL.
Style No. 608

APR 2 3 1985

MAJOR REVISION DATE
BY NRP CHKD with APVD NRP
REQ. OLD STOCK / REQ. REASON
1 X USE
2 — REWORKABLE
3 — SCRAP/NEW
4 — SCRAP NOW
USE: 1 — SAFETY 5 — STOCK; 2 — MATL 6 — COST; 3 X IMPROVE 7 — MKTG/SALES; 4 — ERROR
ADD 2ND MAT'L REF No. FOR O2 SERVICE. REFERENCE FGS 8A11

© FISHER CONTROLS, 1982, 1985

FISHER

GLASS FILLED PTFE PACKING
CONFIDENTIAL

By JWT	6-14-43
Apvd TMD	2-18-82
Page 1	of 1
Rev WHH	4-15-87

©Fisher Controls 1982, (1987) 1989

1. SCOPE

This specification covers glass fiber reinforced PTFE V-ring products used as valve stem packing.

2. MATERIAL REFERENCE NO. 0117

3. COMPOSITION

V-ring packing made of PTFE (polytetrafluoroethylene), 15-20% glass fibers, compound and inorganic coloring.

4. TEMPERATURE RANGE

0° F to + 450° F

5. APPROVED SOURCE

EPSCO, Inc.
(Div. of Peabody Gore')
Houston, TX
Style: Fluorogreen E110

MAY 31 1989

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHK'D TDS APVD NER

Obsolete - superseded by FMS 17014

FISHER®
OVERNOR CO.
IBHALLTOWN, IOWA
USA

GLASS FILLED TFE PACKING
JOHN L. DORE' E110 ONLY

ISSUED JWT 6-14-63
REV. ERB 9-15-65
PAGE 1 OF 1

CONFIDENTIAL

1. SCOPE

This specification covers glass fiber reinforced TFE V-ring products used as valve stem packing.

2. MATERIAL REFERENCE NO. D117

3. COMPOSITION

V-ring packing made of TFE resin (polytetrafluoroethylene), 15-20% glass fibers, compound and inorganic coloring

V-Ring Packing Made Of TFE Resin, Glass Fibers, Compounder, and Inorganic Coloring — omit

4. APPROVED SOURCE

EPSCO, Inc.
(Div. of Peabody Dore')
Houston, TX.
Style: Fluorogreen E110

Approved Materials

John L. Dore' Fluorogreen No. E110 — omit

FEB 23 1982

MAJOR REVISION DATE
BY CHKD APVD
140. OLD STOCK
1 USE
2 — REMACHINE
3 — SCRAP/REW
4 — WORK
130. REASON
1 — SAFETY
2 — WEAR
3 IMPROVE
4 — ERROR
5 — ECDR
6 — COST
7 — MERCH

Update to current specs. and format.

THIS PRINT IS THE PROPERTY OF FISHER GOVERNOR CO.

OBSOLETE

TFE impregnated asbestos rings for oxygen service

Specify: TFE Asbestos - FMS 17D11

The packing material covered by this specification is intended for use with liquid or gaseous oxygen and must meet the following specifications:

1. Must not contain organic matter, dirt or oil.
2. Supplier must furnish with tag certifying cleanliness, viz: "This packing is clean, free from oil, and is suitable for oxygen service." Signed _____ Inspector.

Approved Material

Martin Merkel, Inc.
Cleveland, Ohio 44139
Style: Union #5712

MAJOR REVISION APR 22 1987

ECR/N NO. _____ DATE>
BY WHH CHKD DRB APVD MFR
BSO. OLD STOCK
1 X USE until 4-30-87 then scrap
2 — REWORK
3 — SCRAP/REW
4 — SCRAP NOW
EXPLAIN
BSO. REASON
1 — SAFETY
2 X MAT'L
3 — IMPROVE
4 — ERROR
5 — STOCK
6 — COST
7 — MKTG/
— SALES

Obsolete, see none. Asbestos elimination program

© FISHER CONTROLS, 1981, 1986

Asbestos - TFE Impregnated Packing For Oxygen Service				SIZE	TYPE
FISHER GOVERNOR CO. MARSHALLTOWN, IOWA		BY	DATE	FILE	SUPERSEDES
	DWN.	J.K.	4-28-61	SCALE	DESIGN
	CHK.	WHH	4-28-61		

INACTIVE

Packing To Be Square Braided Blue African Asbestos Impregnated With TFE And Furnished In Ring Form With Bevel Joint. Packing must be free of excessive graphite and dirt.

The Following Materials Have Been Approved:

Johns-Manville Style No. 2014

Garlock, Inc. No. 5561

INACTIVE

SEP 21 1982

MAJOR REVISION DATE
BY RRH CHKD [illegible] APVD GFB

NO. OLD STOCK		REASON	
1 X USE		1 __ SAFETY	5 __ STOCK
2 __ REMACHINE	REASON	3 __ MAT'L	6 __ COST
3 __ SCRAP/REW		5 X IMPROVE	
4 __ SCRAP NOW		4 __ ERROR	

Make inactive — no longer needed.

© Fisher Controls 1982

E

REVISIONS		
DATE	BY	CHKD.
3-15-65	ERB	[illegible]
6-29-67	IRB	[illegible]

TITLE Blue African Asbestos- TFE Packing

	BY	DATE
DWN.	WHP	2-8-56
TRCD.		
CHKD.	HGK	2-17-56
APPR.		
SCALE		

FISHER ® GOVERNOR CO. MARSHALLTOWN, IOWA

DESIGN NO.
DRAWER NO.
SUPERSEDES NO.

TYPE
SIZE INACTIVE D
DIO REV.

TAYLOR V. 3.M. COMPANY ET AL.
FISHER 000525

ROA_03638

CONFIDENTIAL

HIGH TEMPERATURE PACKING

Used where packing temperatures are in excess of 450° F.

Recommended for service to 900° F.

Packing shall consist of two types of rings.

Metallic Rings: Use one at the bottom of the box and one at the top. If lantern gland is furnished use one on each side of the lantern gland. Metallic rings shall consist of a high grade asbestos core about which treated, crinkled aluminum alloy foil sheets are twisted.

Plastic Rings: Use to fill space between metallic rings to give proper packing depth. Plastic rings shall consist of pure, long asbestos fibres and aluminum shreds lubricated.

The following materials have been approved:

Metallic Rings

Durametallic Style D-110 or D-10 (Alternate)

Plastic Rings

Durametallic Style D-222 or D-2 (Bulk alternate)

MINOR REVISION 4-15-56
DATED
BY NEP ADDED NEP.
REFORMAT & ELIMINATE ASBESTOS

			TITLE	High Temperature Packing			TYPE	
				BY	DATE	FISHER GOVERNOR CO. MARSHALLTOWN, IOWA	DESIGN NO.	
			DWN.	Capt	4-11-56		DRAWER NO.	SIZE B
			TRCD.					
			CHKD.	WMT	4-11-56		SUPERSEDES DWG. NO.	DWG. NO. FMS 1709
DATE	BY	CHKD.	APPR.					
REVISIONS			SCALE					

Fisher Controls	Material Specification	No. FMS 17D8	H
	TFE ASBESTOS - PACKING	By MMP 8-12-54	
FISHER		Apvd TKB 2-18-82	
		Page 1 of 1	
©Fisher Controls 1982, 1985		Rev NRP 10-30-85	

OBSOLETE

1. SCOPE

This specification covers square braided asbestos valve stem packing impregnated with TFE (polytetrafluorethylene).

2. MATERIAL REFERENCE NO. 0104

3. COMPOSITION

Square braided asbestos impregnated with TFE and furnished in ring form with bevel joint.

3.1 Packing should be reasonably clean and free from graphite. Not for oxygen service.

3.2 Note: For oxygen service specify FMS 17D11

4. APPROVED SOURCE

(a) Argo Packing Co.
P.O. Box 66
Oakmont, PA. 15139
Style No. 715

(b) Martin Merkel Packings and Seals, Inc.
5375 Naiman Parkway, Suite B
Cleveland, OH. 44139
Style No. 5741

MAJOR REVISION APR 82 1987
EGR/M NO. _____ DATE
BY WHH CHKD PRB APVD KPK
840. OLD STOCK
1 USE until 4-30-87 then scrap
2 — REWORK
3 — SCRAP/NEW
4 — SCRAP NOW
EXPLAIN
030. REASON
1 — SAFETY
2 MATL
3 — IMPROVE
4 — ERROR
5 — STDZN
6 — COST
7 — MKTG/SALES
Obsolete, see FMS 17D26
Asbestos elimination program

FMS3-27/1

Fisher Controls | Material Specification | FMS 17D7

FISHER

PTFE RING PACKING

CONFIDENTIAL

Rev: (4) M
By: MMP 5-17-50
Apvd: PLP 5-14-76
Page 1 of 1

©Fisher Controls 1982, (1987) 1991 Revised By: WHH 1-24-89
WHH 4-30-91

1. SCOPE

This specification covers virgin PTFE V-Ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS.

(a) 0102

(b) 0111 for oxygen service, clean and handle per FGS 8A11

(c) 018M for less than 200 ppm leachable chloride per FMS 17D16

3. COMPOSITION

Molded or machined plastic V-ring packing made of unfilled virgin PTFE (polytetrafluoroethylene), such as DuPont's Teflon 8B. Material should comply with FDA regulations. Small c

4. TEMPERATURE RANGE

-40°F to +450°F

5. APPROVED SOURCES

(a) Crane Packing Co. John Crane International
Morton Grove, IL
Style Nos. Chemlon C-VU or C-VH (High Pressure)

(b) Chicago Gasket Co.
Chicago, IL
Style No., VZO-CVU

(c) Halogen Insulator & Seal Co. Norton Performance Plastics
Elk Grove, IL
Style No. 100 CVU

(d) Argo Packing Co.
Oakmont, PA
(To be used only on rotary valve products with shafts over 2" diameter.)

(e) Garlock-Mechanical Packing Div.
Sodus, NY
Style No. 7500

MAY 02 1991

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD JKB APVD MCP
EXPLAIN: 1 OLD STOCK, 2 USE, 3 REWORK, 4 SCRAP/REW, 5 SCRAP NOW
REASON: 1 SAFETY, 2 MATL, 3 IMPROVE, 4 ERROR, 5 STDZN, 6 COST, 7 MKTG/SALES

Update vendor names

Fisher Controls | Material Specification | FMS 17D7

PTFE RING PACKING

Rev: (J) K
By: MRP 5-17-50
Apvd: PGF 5-14-76
Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls 1982, 1988 Revised By: WHH 2-17-88

1. SCOPE

This specification covers virgin PTFE V-Ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS.

(a) 0101

(b) 0111 for oxygen service, clean and handle per FGS SHALL

(c) 018H for less than 200 ppm leachable chloride per FSS 17D16

3. COMPOSITION

Molded or machined plastic V-ring packing made of unfilled virgin PTFE (polytetrafluoroethylene).

4. TEMPERATURE RANGE

-40°F to +450°F

5. APPROVED SOURCES

lower case → (A) Crane Packing Co.
Morton Grove, IL
Style Nos. Chemlon C-VU or C-VH (High Pressure)

(b) Chicago Gasket Co.
Chicago, IL
Style No., V20-CVU

(c) Halogen Insulator & Seal Co.
Elk Grove, IL
Style No. 100 CVU

(d) Argo Packing Co.
Oak mont, PA
(To be used only on rotary valve products with shafts over 2" diameter.)

APR 11 1988

MAJOR REVISION

DSN'N RQ. _____ DATE
BY WHH CHKD JLG APVD MFR

Add additional source, correct type.

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03642

Fisher Controls | Material Specification | FMS 17D7

PTFE MOLDED RING PACKING

Rev: (G) H
By: MNP 5-17-50
Apvd: PLT 6-14-76
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1982, 1987

Revised By: WHH 9-15-87

1. SCOPE

This specification covers virgin PTFE V-Ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS.

(a) 0101

(b) 0111 for oxygen service, clean and handle per FGS 6A11

(c) 010M for less than 200 ppm leachable chloride per FMS 17D16

3. COMPOSITION

Molded plastic V-ring packing made of unfilled virgin PTFE (polytetrafluoroethylene).

4. TEMPERATURE RANGE

-40°F to +450°F

5. APPROVED SOURCES

(A) Crane Packing Co.
Morton Grove, IL
Style No. 772-8V
Style: Chemlon C-VH (High Pressure)

Style Nos. Chemlon CVU or CVH (High pressure)

(b) Chicago Gasket Co.
Chicago, IL
Style No., V20-CVU

(c) Halogen Insulator & Seal Co.
Elk Grove, IL
Style No. 100 CVU

DEC 04 1987

MAJOR REVISION

ECR/N NO. _____ DATE>
BY WHH CHKD DRB APVD NER

REQ. OLD STOCK
1 ☒ USE
2 ☐ REWORK
3 ☐ SCRAP: REWORK
4 ☐ SCRAP: NEW

EXPLAIN

STD. REASON
1 ☐ SAFETY
2 ☐ SEAL
3 ☒ INTERCHANGE
4 ☐ ERROR
5 ☐ STOCK
6 ☐ COST
7 ☐ RETRO/SALES

Make correction to material designation

Fisher Controls | Material Specification | No. FMS 17D7 E

FISHER | PTFE MOLDED RING PACKING | CONFIDENTIAL | By MHP 5-17-5(; Apvd PLT 5-14-7(; Page 1 of 1

©Fisher Controls 1982, 1986 | Rev NRP 1-13-8(

1. SCOPE

This specification covers virgin PTFE (FP) V-ring products used as valve stem packing.

2. MATERIAL REFERENCE NOS.

(a) 0101

(b) 0111 for oxygen service, clean and handle per FGS 8A11

(c) 018M for less than 200 ppm leachable chloride per FMS 17D16

3. COMPOSITION

Molded plastic V-ring packing made of unfilled virgin (TFE resin) PTFE (polytetrafluoroethylene).

4. APPROVED SOURCES

5.

(a) Crane Packing Co.
Morton Grove, IL
Style No. 772-SV

(b) Chicago Gasket Co.
Chicago, IL
Style No. V20-CVU

(c) Halogen Insulator & Seal Co.
Elk Grove, IL
Style No. 100 CVU

FMSD-36/1

1. TEMPERATURE RANGE

−40°F to +450°F

MAJOR REVISION APR 22 1987

ECR/N-NO. DATE

BY WHH CHKD DRB APVD

Standardize matl. description
Add temp. range.

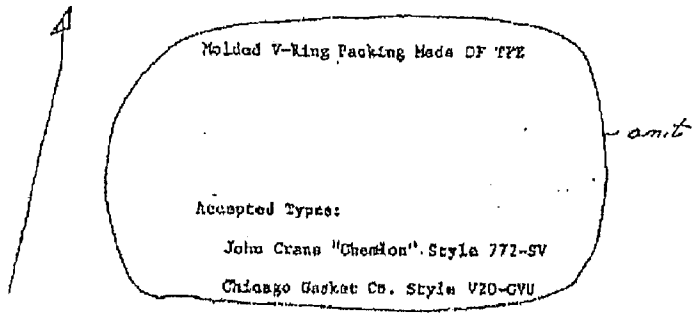
FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

MOLDED RING PACKING

CONFIDENTIAL

NO. THS 1701	D-(C)
BY MAP	5-17-50
APVD PLT	5-14-75
PAGE 1	OF 1
REV XLR	5-7-76



1. SCOPE

This specification covers virgin TFE v-ring products used as valve stem packing.

2. MATERIAL REFERENCE NO. and

3. COMPOSITION

Molded plastic v-ring packing made of unfilled virgin TFE resin (polytetrafluoroethylene).

4. APPROVED SOURCES

(a) Crane Packing Co.
Morton Grove, IL
Style No. 772-SV

(b) Chicago Gasket Co
Chicago, IL
Style No. V20-CVU

(c) Halogen Insulator & Seal Co.
Elk Grove, IL
Style No. 100 CVU

FEB 23 1982

MAJOR REVISION
BY CHKD APVD TKB
ECN
BAD OLD STOCK — REQ. REASON
1 — CAUSE
2 — MECHANICAL — 1 — SAFETY 5 — STOCK
3 — SCRAP/REW — 2 — MATL 6 — COST
4 — [illegible] — 3 — IMPROVE 7 — [illegible]
— 4 — ERROR — SALES

Add new source and revise to new format

Fisher Controls	Material Specification	No. FMS 17D5	D
	GRAPHITED ASBESTOS PACKING	By GFB	4-7-49
FISHER	CONFIDENTIAL	Apvd TRB	1-25-83
		Page	1 of 1
©Fisher Controls 1982, 1987		Rev WHH	4-15-87

OBSOLETE

1. SCOPE

This specification covers a graphited asbestos compound for use as valve stem packing.

2. MATERIAL REFERENCE NO. 0106

3. COMPOSITION

Molded or die formed ring packing made of asbestos fiber, graphite and treated with a surface lubricant in braided jacket over core construction.

4. APPROVED SOURCE

Argo Packing Co.
P.O. Box 66
Oakmont, PA. 15139
Style No. 600

OBSOLETE SUPERSEDED BY QWG NA
FMS 17D28

INACTIVE

CONFIDENTIAL

Packing shall be made from high grade Canadian white asbestos. The string shall be formed by twisting together lubricated single strands of asbestos.

Diameter of the packing shall be specified by the Fisher Governor Company.

The packing shall be suitable for use with air, hot water and steam up to 800°F.

The following materials have been approved:

1. Palmetto String Packing - Greene, Tweed & Company

INACTIVE BY [illegible]

String Packing For Air, Hot Water & Steam				SIZE		TYPE	
FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA		BY:	DATE	FILE	SUPERSEDES	DWG. NO.	REV.
	DWN.	RKJ	10-6-48	SCALE	DESIGN	EMS17D4	B
	CHKD.	[illegible]	6-22-59				

CONFIDENTIAL

PACKING SHALL BE MADE FROM LONG FIBRE ASBESTOS YARN BY THE BRAID OVER BRAID METHOD. PACKING IS TO BE LUBRICATED AND GRAPHITED. FINISHED PRODUCT SHALL BE RESISTANT TO STEAM, WEAK ACIDS, GAS, LYE AND CAUSTICS.

PACKING SHALL BE FURNISHED IN ROPE FORM.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. GARLOCK NO. 233 (COIL FORM).

INACTIVE BY 8/22/83

			TITLE BRAIDED ROPE PACKING - FOR STEAM, WEAK ACID, GAS, LYE OR CAUSTIC SODA.			TYPE	
				BY	DATE	DESIGN NO.	
DATE	BY	CHKD.	DWN.	BRO	10-6-43		SIZE
REVISIONS			TRCD.			DRAWER NO.	
			CHKD.				
SUPERSEDES DWG. NO. FM5381			APPR.			FILE NO.	DWG. NO. FM5117D3
			SCALE				

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

ALL DIMENSIONS ARE IN INCHES

CONFIDENTIAL

FORMED PACKING TO BE MADE OF METAL PARTICLES, OIL-PROOF BINDER, LONG FIBRE ASBESTOS AND MUST BE SUITABLE FOR USE ON OILS AND PETROLEUM DISTILLATES AT TEMPERATURES UP TO 650°F.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED:

1. JOHN CRANE SUPER-SEAL NO. 3.

			TITLE FORM PACKING-LONG FIBRE ASBESTOS, OIL-PROOF BOUND			TYPE	
				BY	DATE	DESIGN NO.	SIZE
DATE	BY	CHKD.	DWN.	[illegible]	10-6-43	DRAWING NO.	
REVISIONS			TRCD.				
SUPERSEDES DWG. NO. FMSSA1			CHKD.			FILE NO.	DWG. NO. FMS1TD1
			APPR.				
			SCALE				

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

CONFIDENTIAL

Material shall be compounded of cork particles and fibre compressed into sheet form. The sheet must have high compressibility, resilience, and tensile strength, and good flexibility.

The following materials have been approved:

1. Vellumoid No. 444 (Federal-Mogul)

DEC 21 1983

DATE

NEP WHH NFR DWH(S)

MONTHLY REVIEW – PUT IN WEAJ. FORMAT-CORRECTED

Cork Sheet Compounded Cord & Fibre Sheet				SIZE	TYPE COMPANY NAME	
FISHER GOVERNOR CO. MARSHALLTOWN, IOWA		BY	DATE	FILE	SUPERSEDES	DWG. NO.
	DWN.	BBJ	10-6-43	SCALE	DESIGN	FMS17B1
	CHKD.	[illegible]	6-12-59			

C

REV. B

Fisher Controls

Document Cover Sheet

FMS 17A6

FISHER

FLAT SHEET COMPOSITION GASKET MATERIAL (CLOSE TOLERANCE)

CONFIDENTIAL

Rev: J
By: MHH 10-14-05
Apvd: NFR 10-14-05
Page 1

*Fisher Controls 1985, 1992

Revised By: MHH 4-30-92

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
1	J						
2							
3							
4							

MAJOR REVISION 5-27-97

AUG 5 - 1997

ECRN No. 961378 Date >

By HLH Chkd PMD Apvd TAG

040_Old Stock
1 X USE
2_ REWORK
3_ SCRAP/NEW
4_ SCRAP NOW

630_Reason
1_SAFETY
2_MATL
3_IMPROVE
4_ERROR
5_STDZN
6_COST
7_MKTG/SALES

Explain

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | FMS 17A8

FLAT SHEET COMPOSITION GASKET MATERIAL (CLOSE TOLERANCE)

Rev: (D)+
By: WHH 10-14-85
Apvd: NFR 10-14-85
Page 1 ~~of 2~~ omit

FISHER

ADD Cover Page

*Fisher Controls 1985, (1991) 1992 — Revised By: WHH 10-10-91

CONFIDENTIAL 4-30-92

1. SCOPE

1.1 This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

1.2 * INCLUDED REFERENCES

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17F30)

See Next Page 2

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ± .003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to +302°F (or 150°C).

MAY 27 1992

5. QUALIFICATION TESTING

Moved to Page 3

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div., Palmyra, NY
Compound: Blue-Gard 3000 (Blue color with dark blue square grid)
Compound: 3003 (Lt. yellow color, no markings)
Compound: 3000 from Mexico (Lt. gray color, silver square grid)

(b) Durabla Manufacturing Co., Lionville, PA
Compound: Durlon (Lt. yellow-green color, silver Durabla triangle)

(c) Asberit S.A., Rio De Janeiro, Brazil
Imported by: Sealing Composites Co., P.O. Box 924306, Houston, TX Houston, TX 77292-4306
Compound: Asberit NA-1001 (Lt. green color, no markings)

(d) Lydall, Composite Materials Div., Manchester, CT
Compound: Nobestos D-7201-R (Black color, no markings)

ECR/N NO. DATED 4-30-92
BY WHH CHKD ZOE APVD NFR
ENG. MFGR'G 5 STOCK
PURCH 6 COST
QUALITY 7 MATRL
SERVICE 8 BASIS
MKTG

* Reference Specifications for Included Components

FLAT SHEET COMPOSITION GASKET MATERIAL
(CLOSE TOLERANCE)

FISHER

CONFIDENTIAL

Rev: (F)G
By: WRH 10-14-85
Apvd: NFR 10-14-85

©Fisher Controls 1985, (1990) 1991 Revised by: W RH (4-16-90) 10-10-91

1. SCOPE

This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17P30)

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ± .003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to +302°F (or 150°C).

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div., Palmyra, NY
Compound: Blue-Gard 3000 (Blue color with dark blue square grid)
Compound: 3003 (Lt. yellow color, no markings)
Compound: 3000 from Mexico (Lt. grey color, silver square grid)

(b) Durabla Manufacturing Co., Lionville, PA
Compound: Durlon (Lt. yellow-green color, silver Durabla triangle)

(c) Asberit S.A., Rio De Janeiro, Brazil
Imported by: Sealing Composites Co., P.O. Box 924306, Houston, TX
Houston, TX 77292-4306
Compound: Asberit NA-1000 (Lt. green color, no markings)
(Gel)

(d) Lydall, Composite Materials Div., Manchester, CT
Compound: Nobestos D-7201-B (Black color, no markings)

OCT 30 1991

BY WRH CHKD TGS APVD NFR
Changes, Compounds, change requirements
Declassify

*Fisher Controls 1985, (1989) 1990

Revised By: WHH 7-18-89

1. SCOPE

This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17r30)

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ± .003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to +302°F (or 150°C).

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div., Palmyra, NY
Compound: Blue-Gard 3000 (Identified by blue color with dark blue square dot)
Compound: 3003 (Identified by lt. yellow color, no markings)
Compound: 3000 from Mexico (Identified by lt. gray color, silver square dot)

(b) Durabla Manufacturing Co., Lionville, PA
Compound: Durlon (Identified by lt. yellow-green color, silver Durabla triangle)

(c) Asberit S.A.
Rua Da Ajuda, 35
6th Floor, P.O. Box 716
Rio De Janeiro, Brazil
Compound: Asberit 8A-1000 (Identified by lt. green color, no markings)
Imported by:
Sealing Composites Co.
P. O. Box 924306
Houston, TX 77292-4306

(d) Lydall, Composite Materials Div., Manchester CT
Compound: Nobastos D-7201-R (Black color, no markings)

Fisher Controls | Material Specification | FMS 17A6

FLAT SHEET COMPOSITION GASKET MATERIAL (CLOSE TOLERANCE)

FISHER

CONFIDENTIAL

Rev: (D) E
By: WHH 10-14-85
Apvd: NFR 10-14-85
Page 1 of 2

*Fisher Controls 1985, (1988) 1989 Revised By: WHH 9-19-88

1. SCOPE

This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17F30)

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ± .003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to (+450°F) +302°F (or 150°C)
delete

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

JUL 24 1989

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div., Palmyra, NY
Compound: Blue-Gard 3000 (Identified by blue color with dark blue square gird)
Compound: 3003 (Identified by lt. yellow color, no markings)
Compound: 3000 from Mexico (Identified by lt. gray color, silver square gird)

(b) Durabla Manufacturing Co., Lionville, PA
Compound: Durlon (Identified by lt. yellow-green color, silver Durabla triangle)

(c) Asberit G.A.
Rua Da Ajuda, 35
26th Floor, P.O. Box 716
Rio De Janeiro, Brasil
Compound: Asberit NA-1000 (Identified by lt. green color, no markings)

delete
Imported by:
Prudential Corp.
122 E. 42nd Street
New York, NY 10168-0136

Sealing Composites C
P.O. Box 924306
Houston, TX
77292-4306

Fisher Controls | Material Specification | FMS 17A6

FLAT SHEET COMPOSITION GASKET MATERIAL
(CLOSE TOLERANCE)

Rev: (C) D
By: WHH 10-14-85
Apvd: NFR 10-14-85
Page 1 of 2

FISHER

CONFIDENTIAL

*Fisher Controls 1985, 1988

Revised By: WHH 9-16-88

1. SCOPE

This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17P30)

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ± .003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to +450°F.

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

SEP 26 1988
MAJOR REVISION

ECR/N NO. _____ DATE
BY WHH CHKD RJ APVD NFR
WAS (NO CHG) | SEQ. REASON
1 X COST | 1 — SAFETY | 6 — STOCK
2 — PERFORM | 2 — MATL | 6 — COST
3 — SCRAP/REW | 3 — IMPROVE | 7 — MATG/
4 — SCRAP FGE | 4 — ERRATA | — SALES
Add identification color & marking

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div., Palmyra, NY
(Palmyra, NY)
Compound No.: Blue-Gard 3000 or Garlock 3003
Also Garlock 3000 from Garlock de Mexico

(b) Durabla Manufacturing Co., Lionville, PA
(Lionville, PA)
Compound: Durlon (Identified by lt. yellow-green color, silver Durabla triangle)

(c) Asberit S.A.
Rua Da Ajuda, 35
26th Floor, P.O. Box 716
Rio De Janeiro, Brazil
Compound: Asberit NA-1000

Imported by:
Prudential Corp.
122 E. 42nd Street
New York, NY 10168-0136
(Compound: Asberit NA-1000)
(Identified by lt. green color, no markings)

FMS2-19/1

Compound: Blue-Gard 3000 (Identified by blue color with dark blue square grid)
" 3003 (Identified by lt. yellow color, no markings)
" 3000 from Mexico (Identified by lt. gray color, silver square grid)

Fisher Controls | Material Specification | FMS 17A6

FLAT SHEET COMPOSITION GASKET MATERIAL
(CLOSE TOLERANCE)

FISHER

CONFIDENTIAL

Rev: G
By: WHH 10-14-85
Apvd: NFR 10-14-85
Page 1 of 2

©Fisher Controls 1985, 1988

Revised By: CJ 2-17-89

1. SCOPE

This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17F30)

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ± .003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to +450°F.

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div.
Palmyra, NY
Compound No.: Blue-Gard 3000 or Garlock 3003
Also Garlock 3000 from Garlock de Mexico

(b) Durable Manufacturing Co.
Lionville, PA
Compound: Durlon

(c) Asberit S.A.
Rua De Ajuda, 35
26th Floor, P.O. Box 716
Rio De Janeiro, Brazil
Compound: Asberit NA-1000

Imported by:
Prudential Corp.
122 E. 42nd Street
New York, NY 10168-0136
Compound: Asberit NA-1000

AUG 28 1989

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD RJ APVD NFR
DWG. OR O STOCK
1 X USE
2 — REWORK
3 — SCRAP/RTN
4 — SCRAP NOW
REASON
1 — SAFETY
2 — WAIT
3 X IMPROVE
4 — ERROR
5 — STAN
6 — COST
7 — MISC

Fisher Controls	Material Specification	No. FMS 17A6	B
FISHER	FLAT SHEET COMPOSITION GASKET MATERIAL (CLOSE TOLERANCE)	By WHH 10-14-85	
		Appd NFR 10-14-85	
		Page 1 of 2	
©Fisher Controls 1985, 1988		Rev	

CONFIDENTIAL

1. SCOPE

This specification covers elastomer bound high temperature organic and/or inorganic fiber based flat sheet gasket materials. These materials are used for general purpose gasketing and are designed to replace similar asbestos based gasket materials. They are typically used to seal against oils, water, steam, air, natural gas and many other fluids and gases.

2. MATERIAL REFERENCE NO. 0466 (or 0467 for low chloride per FMS 17F30)

3. MATERIAL COMPOSITION

The material shall be composed of high temperature organic and/or inorganic fibers with nitrile elastomeric binder. Some inorganic filler may be used as long as the resulting sheet material meets the physical properties listed in Table 1. The material should contain no asbestos or cellulose fiber. The thickness and thickness tolerance of the gasket material shall be 0.031 ±.003 inches.

4. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures up to +450°F.

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

6. APPROVED MATERIALS

(a) Garlock, Mechanical Packing Div.
Palmyra, N.Y.
Compound No.: Blue-Gard 3000 OR GARLOCK 3003
Identification: Blue Sheet with 2" square pattern, one side — delete

(b) Durabla Manufacturing Co.
Lionville, PA
Compound: Durlon
Identification: Light Yellow/Green Sheet with Durabla Triangle marking, one side — delete

ASBERIT S.A.
RUA DA AJUDA, 35
14TH FLOOR, ROOM 1416
RIO DE JANEIRO, BRAZIL
COMPOUND: ASBERIT HA-1000

IMPORTED BY:
PRUDENTIAL CORP.
131 E. 42nd Street
NEW YORK, N.Y. 10016-0181
COMPOUND: ASBERIT HA-1000

MAR 02 1988

MAJOR REVISION

SCN/SR NO. _____ DATE
BY RLT CHKD WHH APVD NFR

TAYLOR V. 3.M. COMPANY ET AL.
ROA_03658

FISHER

CONFIDENTIAL

©Fisher Controls 1985, 1991 1992

Revised By: WHH 10-10-91
4-30-92

Moved TO PAGE 1

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "B" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	9 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max
Fluid Resistance (a) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change % wgt. change	15 max. (2) 20 max.
(b) ASTM, #3 oil, 4d, RT	FGS 11A5	% thk. change % wgt. change	15 max. (2) 20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change % thk. change	10 max. (2) ±5
(d) Methenol 4d, RT +air dry	FGS 11A5	% thk. change % thk. change	10 max. (2) ±5
Sealability N, at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	30 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

MAY 27 1992
DATE
FOR REVISION OR MAJOR REVISION STAMP INFORMATION SEE COVER SHEET
REVISION K TO L

FISHER

CONFIDENTIAL

*Fisher Controls 1965, (1990) 1991

Revised By: WHH (4-16-96) (10-10-97)

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FCS 11A1	Shore "D" Durometer	90 ±5
Resilience	FCS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FCS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep.	FCS 11A4	% thk. change after init. change	5 max.
Compressibility, 6000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max
Fluid Resistance (a) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change % wgt. change	15 max. (2) 20 max.
(b) ASTM, #3 oil, 4d, RT	FCS 11A5	% thk. change % wgt. change	15 max. (2) 20 max.
(c) Hexane, 4d, RT +air dry	FCS 11A5	% thk. change % thk. change	10 max. (2) ±5
(d) Methanol 4d, RT +air dry	FCS 11A5	% thk. change % thk. change	10 max. (2) ±5
Sealability N_2 at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	(20) 30 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

OCT 30 1991

MAJOR REVISION DATE

ENG/R NO. CHKD APVD

BY WHH

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03660

*Fisher Controls 1985, (1989) 1990 Revised By: WHH 7-18-89

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "D" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max
Fluid Resistance	ASTM F146	% thk. change	0 to 15 (2)
(a) ASTM #3 oil, 5 hr., 300°F		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM #1 oil 4d, RT	FGS 11A5	% thk. change	0 to 15 (2)
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
(d) Methanol 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
Sealability N, at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

FISHER

CONFIDENTIAL

©Fisher Controls 1985, 1988, 1989 Revised By: WHH 9-19-88

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "B" Durometer	90 ±6
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4.	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
(d) Methanol 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
Sealability N, at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

MAJOR REVISION — DATE JUL 24 1989 — ENGR/M NO. — BY WHH — CHKD — APVD

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03662

FISHER CONFIDENTIAL

*Fisher Controls 1985, 1989

Revised By: WHH 8-16-88

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "D" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(c) Hexane, 4d, RT	FGS 11A5	% thk. change	0 to 10 (2)
+air dry		% thk. change	±5
(d) Methanol 4d, RT	FGS 11A5	% thk. change	0 to 10 (2)
+air dry		% thk. change	±5
Sealability N, at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

MAJOR REVISION — DATE SEP 26 1988
ECN/M NO. — APVD
BY WHH

©Fisher Controls 1985, 1988 Revised By: RJF 2-17-88

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "B" Durometer	90 ±6
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk, change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
(d) Methanol 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
Sealability N, at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

MAJOR REVISION
ECR/N NO. _____
BY WHR CHKD RJF APVD NFR DATE AUG 29 1988
BAL. NO. STOCK
1 — RECEIVE
2 — REMARK
3 — SCRAP/REW
4 — REWORK
5 — STORE
6 — MAIL
7 — DOC
8 — TELEPHONE
9 — RETURN/
10 — CHECK
11 — STATES
DEPARTMENTS
Field Purchase to Metric equiv.

Fisher Controls | Material Specification | No. FMS 17A5 E

FISHER | FLAT SHEET COMPOSITION GASKET MATERIAL CONFIDENTIAL | By WHH 4-15-85 | Appvd NFE 4-15-85 | Page 2 of 2

©Fisher Controls 1985, 1988 | Rev NEP 10-29-85

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "A" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max.
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk, change	0 to 10 (2)
		% thk, change	±5
(d) Methanol 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
Sealability N_2 at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

MAR 02 1988

KAISER REVISION

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

TABLE 1
Qualification Tests

10-29-86

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "B" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max.
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
(d) Methanol 4d, RT +air dry	FGS 11A6	% thk. change	0 to 10 (2)
		% thk. change	±5
Soalability N_2 at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

NOV 7 1985

MAJOR REVISION
N/A
ECR/N NO. ____ DATE
BY NEP CHKD WHH APVD NFB
PAGE 1 OF 2

Fisher Controls | Material Specification | No. FMS 17A5 (B)

FISHER | FLAT SHEET COMPOSITION GASKET MATERIAL | By WHB 4-15-85 | Apvd NRP 4-16-85

CONFIDENTIAL | Page 2 of 2

©Fisher Controls | Rev NRP 7-10-85

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "B" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	5 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max.
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
(d) Methanol 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
Sealability N$_2$ at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

ADD LOW CHLORIDE MNR

OCT 2 1 1985

MAJOR REVISIONS

ECR/N NO. N/A DATE

AS NSP APVD AUTH APVD

ADD TOLERANCES FOR GASKET THICKNESS

Fisher Controls — Material Specification — No. FMS 17A5 (A)

FISHER

FLAT SHEET COMPOSITION GASKET MATERIAL

By W HH 4-15-85
Appd NFR 4-15-85
Page 2 of 2

© Fisher Controls 1985

Rev.

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "A" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A4 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	6 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max.
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change % wgt. change	0 to 15 (2) 20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change % wgt. change	0 to 15 (2) 20 max.
(c) Hexane, 4d, RT fair dry	FGS 11A5	% thk. change % thk. change	0 to 10 (2) ±5
(d) Methanol 4d, RT fair dry	FGS 11A5	% thk. change % thk. change	0 to 10 (2) ±5
Sealability N_2 at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

MAJOR REVISION — ECR/N NO. — DATE — BY — CHKD — APVD

Remove to Supplier Part Ref. No. Change Storage Temp. Stamp

Fisher Controls | Material Specification | No. FMS 17A6 (A) | B

FISHER | FLAT SHEET COMPOSITION GASKET MATERIAL | By WHH 4-15-85 | Aprvd NFR 4-15-85

CONFIDENTIAL | Page 2 of 2

©Fisher Controls 1985 | Rev

TABLE 1
Qualification Tests

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "A" Durometer	90 ±5
Resilience	FGS 11A2	Bashore	30 ±10
Compression Set 15,000 PSI, RT, 24 hr.	FGS 11A6 (Type A)	%	20 max. (1)
24 hr. Creep	FGS 11A4	% thk. change after init. change	6 max.
Compressibility, 5000 psi	ASTM F36	%	5 to 17
Compression Set	ASTM F36	% change based on orig. thk.	10 max.
Fluid Resistance (a) ASTM #3 oil, 5 hr., 300°F	ASTM F146	% thk. change	0 to 15 (2)
		% wgt. change	20 max.
(b) ASTM Fuel B 5 hr., R.T.	ASTM F146	% thk. change % wgt. change	0 to 16 (2) 20 max.
(c) Hexane, 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
(d) Methanol 4d, RT +air dry	FGS 11A5	% thk. change	0 to 10 (2)
		% thk. change	±5
Sealability N_2 at 30 psig 3000 psi gasket load	ASTM F37	ml./hr.	20 max.

Notes:

(1) No delamination on removal from compression test platens.
(2) Hardness change on soak or air dry shall not exceed ±10 points from original hardness.

MAJOR REVISION
ECR/N NO. ____ DATE> 7-15-85
BY NRP CHKD APVD NFR
ENG. GRD STOCK
1 — SAFETY
2 — OVERRIDE
3 — DESIGN
4 — SERVICE MDN
5 — STEAM
6 — COST
7 — MATRL/SALES
INVOLVED
Revise to [illegible]
Mat'l Spec. No.
Change Service Temp. Section

Fisher Controls

Material Specification

FISHER

HEAVY DUTY ELASTOMER-BOUND ASBESTOS GASKET MATERIAL

No.	FMS 11A4	C
By	RGK	2-19-69
Appd	TKO	9-14-82
Page	1	of 1
Rev	WHH	2-15-88

©Fisher Controls 1982

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for nitrile elastomer bound asbestos gasketing and describes the composition of the approved source(s), their product name; and all approved substitutes for the approved source(s).

2. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% nitrile type elastomeric binder.

3. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

4. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

5. MATERIAL SUBSTITUTION

The approved source(s) may be substituted for the material source(s) shown on FMS17A2 provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

There is no approved substitute for FMS17A4 material.

6. APPROVED SOURCE(S)

The following material(s) have been approved:

OBSOLETE
Superseded by FMS 17A5 or 17P38.

(a) Armstrong Accobest AN-8012
(Cooper Manufacturing Co.)
Armstrong Industry Products Div.
Lancaster, PA 17604

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03670

Fisher Controls

Material Specification

HEAVY DUTY ELASTOMER-BOUND ASBESTOS GASKET MATERIAL

FMS 17A4 (B)

By RGK 2-19-69

Appd TKB 9-14-82

Page 1 of 1

©Fisher Controls 1982

Rev DKW 9-14-82

1. SCOPE

OBSOLETE

This specification lists the approved source(s) for nitrile elastomer bound asbestos gasketing and describes the composition of the approved source(s), their product name; and all approved substitutes for the approved source(s).

2. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% nitrile type elastomeric binder.

3. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

4. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

5. MATERIAL SUBSTITUTION

The approved source(s) may be substituted for the material source(s) shown on FMS17A2 provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

OBSOLETE
Superseded by FMS NAS or DF38

There is no approved substitute for FMS17A4 material.

6. APPROVED SOURCE(S)

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD PRB APVD WFR
SAB, OLD STOCK — REQ. REASON
1 — NEW — 5 — SAFETY — 8 — STRENGTH
2 — REWORK — 6 — MATL — 9 — COST
3 — SCRAP/NEW — 7 — IMPROVE — 10 — INTER/EXTER
4 — SCRAP NOW — 4 — ERROR
CIRCLE
Make obsolete — no longer use asbestos
FEB 28 1990

The following material(s) have been approved:

(a) Armstrong Accobest AN-8012
(Cooper Manufacturing Co.)
Armstrong Industry Products Div.
Lancaster, PA 17604

FISHER®
GOVERNOR CO.
MARSHALLTOWN, IOWA
U.S.A.

MATERIAL SPECIFICATION

HEAVY DUTY RUBBER ASBESTOS GASKET MATERIAL
Elastomer Bound

NO. DMS 17A4 B (A)
ISSUED RGK 2-19-69
REV.
PAGE 1 OF 1

Heavy Duty Rubber-Asbestos

Nitrile - butadiene rubber binder

The following materials have been approved.

1) Armstrong Accobest AN-8012
Cooper Manufacturing Company

SEP 21 1982
DATE

MAJOR REVISION
BY CHKD JRP APVD JKB
840, OLD STOCK 830, REASON
5 ... 1 ... SAFETY 6 ... STOCK
4 ... PENACHIEF ... 2 ... WEAR 7 ...
3 ... 7 ... Improved 7 ... 11
Completely rewritten to agree with new format.

Fisher Controls

CONFIDENTIAL

Material Specification

FISHER

ASBESTOS GASKET SHEET
WITH NON-STICKING QUALITIES

No.	FMS 17A3 E
By	HW 5-20-53
Appd	MFP 9-3-A3
Page	1 of 1
Rev	WHH 2-15-88

©Fisher Controls 1983

1. SCOPE

OBSOLETE

This specification lists the approved source(s) for compressed asbestos sheet material used for general purpose gasketing.

2. MATERIAL REFERENCE NO. - 0403

3. MATERIAL COMPOSITION & PROPERTIES

The sheet is to be of the best grade long fiber asbestos and SBR elastomeric binder. When clamped between flanges it must not stick to the flanges, even though they are primed or painted.

4. APPROVED SOURCE(S)

(a) Garlock Mechanical Packing Division
Palmyra, N.Y.
Style No. 900/7735

(b) Nicolet Incorporated
Ambler, Pa.
Style No. 240

OBSOLETE
Superseded by
FMS 17A8 or
17A38

CONFIDENTIAL

Fisher Controls

FISHER

Material Specification

ASBESTOS GASKET SHEET
WITH NON-STICKING QUALITIES

No. FMS 17A3 (D)

By RW 5-20-53

Appd NFR 9-9-83

Page 1 of 1

©Fisher Controls 1983

Rev MRP 9-9-83

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for compressed asbestos sheet material used for general purpose gasketing.

2. MATERIAL REFERENCE NO. - 0403

3. MATERIAL COMPOSITION & PROPERTIES

The sheet is to be of the best grade long fiber asbestos and SBR elastomeric binder. When clamped between flanges it must not stick to the flanges, even though they are primed or painted.

4. APPROVED SOURCE(S)

(a) Garlock Mechanical Packing Division
Palmyra, N.Y.
Style No. 900/7706

(b) Nicolet Incorporated
Ambler, Pa.
Style No. 240

OBSOLETE
FEB 22 1988
superseded by FMS 17A5 or 17A36

MAJOR REVISION

ECR/N NO. _____ DATE

BY WHH CHKD PRO APPD NFR

OBS. OLD STOCK
1 — DIE
2 — REWORK
3 — SCRAP/NEW
4 — SCRAP NOW

EXPLAIN

REVL REASON
1 — SAFETY
2 — MAT'L
3 — IMPROVE
4 — ERROR
5 — STDZN
6 — COST
7 — MKTG/SALES

Make obsolete — no longer use asbestos

CONFIDENTIAL

THE SHEET IS TO BE OF BEST GRADE LONG FIBRE ASBESTOS. WHEN CLAMPED BETWEEN FLANGES IT MUST NOT STICK TO THE FLANGES, EVEN THOUGH THEY ARE PRIMED OR PAINTED.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED.

1. GARLOCK STYLE NO. 900/7735
2. NICOLLET NO. 240

SEP 13 1983

MAJOR REVISION 9/16/83

MONTHLY REVIEW

PLACE IN NEW FORMAT Completely retyped

			TITLE ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES.			TYPE	
				BY	DATE		
			DWN.	HJ	5-20-53	DESIGN NO.	
4-15-83	GW	2.17.84	TRCD.			DRAWER NO.	DECK
10-16-79	M.C.B.	Q.C.	CHKD.				
DATE	BY	CHKD.	APPR.			DWG. NO.	REV.
REVISIONS			SCALE			SUPERSEDED DWG. NO.	FM5177A8

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA

CONFIDENTIAL

THE SHEET IS TO BE OF BEST GRADE LONG FIBRE ASBESTOS. WHEN CLAMPED BETWEEN FLANGES IT MUST NOT STICK TO THE FLANGES, EVEN THOUGH THEY ARE PRIMED OR PAINTED.

THE FOLLOWING MATERIALS HAVE BEEN APPROVED.

1. GARLOCK STYLE NO. 7795

900/7735

10-22-79

MAJOR REVISION
BY TRC CHKD APVD
REP. OLD STOCK
1 — COST
2 — REDESIGN/USE
3 — SCRAP/VIEW
4 — SCRAP NOW
REV. REASON
1 — SAFETY 5 — OTHER
2 — MATL 6 — COST
3 — IMPROVE
4 — ERROR

UP-DATE APPROVED MATL
R. DIXSON

					TITLE ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES		TYPE
				BY	DATE	FISHER GOVERNOR CO. MARSHALLTOWN, IOWA	DESIGN NO.
			DWN.	RW.	5-20-53		DRAWER NO.
			CHKD.				SUPERSEDES DWG. NO.
DATE	BY	CHANGE					SIZE B
							DWG. NO. FLC17A

OBSOLETE

C,G, VK

CONFIDENTIAL

ASBESTOS GASKET SHEET WITH NON-STICKING QUALITIES

The sheet is to be of best grade long fibre asbestos. When clamped between flanges it must not stick to the flanges, even though they are primed or painted.

The following materials have been approved.

1. Garlock style No. 7735

Page 1 of 1

Asbestos Gasket Sheet With Non-Sticking Qualities					SIZE	TYPE	
FISHER® GOVERNOR CO. McKINNEY, TEXAS		BY	DATE	FILE	SUPERSEDES FNS17A3	DWG. NO. T10192	REV. A
	DWN.		11/10/65				
	CHD		11-11-65	SCALE	DESIGN		

CONFIDENTIAL

Fisher Controls	Material Specification	No. FMS 17A2 E
FISHER	HIGH GRADE LONG FIBRE ASBESTOS SHEET GASKET MATERIAL	By C.J.W. 8-1-72
		Appvd TVB 9-14-82
		Page 1 of 1
©Fisher Controls 1983		Rev. Original 8-15-80

OBSOLETE

1. SCOPE

This specification lists the approved source(s) for elastomer bound asbestos gasketing and describes the composition of the approved source(s), their surface resistance, general usage, product name; and all approved substitutes for the approved sources.

2. MATERIAL REFERENCE NO. 0402

3. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% elastomeric binder.

4. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

5. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

6. MATERIAL SUBSTITUTION

The approved material(s) listed under FMS 17A4 may be substituted for the approved material(s) listed below. The substitution may be made provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS 17A2 material.

FMS 17A2 material may not be substituted for FMS 17A4 material.

7. APPROVED SOURCE(S)

The following material(s) have been approved:

(a) Durabla -
Durabla Manufacturing Co.
Paoli, PA 19301

OBSOLETE
Superseded by
FMS 17A5 or
17A6

FMSI-13/1

Fisher Controls	Material Specification	No. FMS 17A2 (15)
FISHER	HIGH GRADE LONG FIBRE ASBESTOS SHEET GASKET MATERIAL CONFIDENTIAL	By CWW 8-7-73
		Appd TKB 9-14-82
		Page 1 of 1
©Fisher Controls 1983		Rev MRP 9-7-83

1. SCOPE

OBSOLETE

This specification lists the approved source(s) for elastomer bound asbestos gasketing and describes the composition of the approved source(s), their surface resistance, general usage, product name(and all approved substitutes for the approved sources.

2. MATERIAL REFERENCE NO. 0402

3. MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% elastomeric binder.

4. SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

5. GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

6. MATERIAL SUBSTITUTION

The approved material(s) listed under FMS 17A4 may be substituted for the approved material(s) listed below. The substitution may be made provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS 17A2 material.

FMS 17A2 material may not be substituted for FMS 17A4 material.

7. APPROVED SOURCE(S)

FEB 22 1988

OBSOLETE
Superseded by
FMS MAT DR
17F28

The following material(s) have been approved:

(a) Durabla -
Durabla Manufacturing Co.
Paoli, PA 19301

MAJOR REVISION

ECR/N NO. _____ DATE

DT. WWW CHKD DRD APPD NPE

SEE OLD STOCK
1 — DSC
2 — REWORK
3 — SCRAP/NEW
4 X SCRAP NOW

EXPLAIN

SEE REASON
1 — SAFETY
2 — MAKE
3 — PERFORM
4 — TERROR
5 — STREN
6 — COST
7 — MKTG/SALES

Make obsolete no longer used

Fisher Controls	Material Specification	No. YMS 17A2	(C) D
FISHER	HIGH GRADE LONG FIBRE ASBESTOS SHEET GASKET MATERIAL CONFIDENTIAL	By CWW 8-7-73
		Appd YKB 9-14-82
		Page 1 of 1
©Fisher Controls 1982, 1983		Rev CWW 9-14-82

1. SCOPE

This specification lists the approved source(s) for (nitrile) elastomer bound asbestos gasketing and describes the composition of the approved source(s), their surface resistance, general usage, product name; and all approved substitutes for the approved sources. omit

2. MATERIAL REFERENCE No. 01102

7.(2) MATERIAL COMPOSITION

The material, as covered by this specification, shall be a compressed asbestos type sheet consisting of about 80-85% asbestos fibers with about 15-20% (nitrile type) elastomeric binder. DELETE

7.(3) SURFACE RESISTANCE OF MATERIAL

The material surfaces shall be resistant to sticking to metals such as brass, aluminum, and steel. The material shall be resistant to compression relaxation under heavy loads.

6.(4) GENERAL USAGE OF MATERIAL

The material shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical, and general processing type industries.

6.(5) MATERIAL SUBSTITUTION

The approved material(s) listed under FMS17A6 may be substituted for the approved material(s) listed below. The substitution may be made provided:

(a) The service conditions are acceptable to allow substitution.

(b) The gasket cutter can furnish cut parts at prices equivalent to those for FMS17A2 material.

FMS17A2 material may not be substituted for FMS17A6 material.

7.(6) APPROVED SOURCE(S)

SEP 13 1983

The following material(s) have been approved:

(a) Durable -
Durable Manufacturing Co.
(Wayne) PA (19087)
Part: 16361

MAJOR REVISION — 9/6/83 DATE
BY HRP CHKD WRH APVD UFR

SIG. OLD STOCK	EXPLAIN	100. REASON
1 X USE		1 __ SAFETY 5 X STOCK
2 __ SERVICING		2 __ WEAR 6 __ COST
3 __ SCRAP/NEW		3 X IMPROVE
4 __ SCRAP NEW		4 __ TRADE

MAT'L UPDATE

Form FC-880M Printed in USA

CONFIDENTIAL

The sheet is to be of best grade long fibre asbestos suitable for high pressure, high temperature service.

Material is to be an homogeneous construction.

The following commercial materials have been approved.

1. Durabla
2. Johns - Manseville JM78 with JM Parting Agent

SEP 21 1982

MAJOR REVISION
BY CHKD APVD
B&M, OLD STOCK
1 Δ USE
2 — REMACHINE
3 — H
4 — NEW, NOW
B&M, REASON
1 — SAFETY
2 — WEAR
3 — BREAKDOWN
4 — LABOR
CODES
5 — STORE
6 — COST
7 — OK
SALES
Completely rewritten to new format & removed Johns-Manville as approved source.

High Grade Long Fibre Asbestos Sheet, Gasket Material				SIZE	TYPE	
CH	CHGV	8-7-73	ENGINEERING	FISHER Controls MARSHALLTOWN, IOWA	BY / DATE	DESIGN
					DWN.	
					CHKD.	DWG. NO. REV.
					APVD.	
					SCALE	DWG. CAT.

Fisher Controls | Material Specification | FMS 17F9

POLYCHLOROTRIFLUOROETHYLENE FILM AND SHEET

Rev: ~~C~~ D
By: RKD 6-12-62
Apvd: TRB 11-8-82
Page 1 of 1

FISHER

©Fisher Controls 1982, 1990 | Revised By: WHH 4-18-95

CONFIDENTIAL

1. SCOPE

This specification covers polychlorotrifluoroethylene film and sheet products used primarily as gaskets, diaphragms and diaphragm protectors.

2. MATERIAL REFERENCE NO. 0504

3. SPECIFICATIONS

(a) Composition: 3M Company's Kel-F resin 10X grade or equivalent.

(b) Form: Film or sheet

(c) Process: Melt extrusion

(d) Typical physical properties:

Tensile strength @ 73°F, ASTM D638	5725 psi
Elongation-at-fail @ 73°F, ASTM D638	150%
Flexural modulus @ 73°F, ASTM D790	180,000 psi
Hardness, ASTM D3240 (Type D)	75-80

12 References

a) ASTM D638 - Test Method for Tensile Properties of Plastics.

b) ASTM D790 - Test Method for Flexural Properties of Reinforced and Unreinforced Plastics.

c) ASTM D2240 - Test Method for Rubber Property - Durometer Hardness

MAJOR REVISION
EORN No. 96198 Date 4/1/97
By DM Clrkd DHN Apvd TBG
840, Old Stock
1 _ USE
2 _ REWORK
3 _ SCRAP/NEW
4 _ SCRAP NOW
Reason
830, Reason
1 _ SAFETY
2 _ LEGAL
3 _ IMPROVE
4 _ ERROR
5 _ STDZN
6 _ COST
7 _ MKTG/SALES

FEB 10 1998

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. ~~NOTHING ELSE~~ CONTINUE.

AVOID REFERENCES

Fisher Controls

Material Specification

delete
KEL-F FILM AND SHEET

POLYCHLOROTRIFLUOROETHYLENE

No.	FMS 17F9	(B)
By	RKG	4-12-82
Appd.	TKB	11-8-82
Page	1 of 1	
Rev.	A/N	11-4-82

©Fisher Controls 1982, 1990

CONFIDENTIAL

1. SCOPE

This specification covers polychlorotrifluoroethylene film and sheet products used primarily as gaskets and diaphragm protectors.

2. MATERIAL REFERENCE NO. 0504 diaphragms

3. SPECIFICATIONS

(a) Composition: 3M Company's Kel-F resin LOX grade or equivalent.

(b) Form: Film or sheet

(c) Process: Melt extrusion

(d) Typical physical properties:

Tensile strength @ 73°F, ASTM D638	5725 psi
Elongation-at-fail @ 73°F, ASTM D638	150%
Flexural modulus @ 73°F, ASTM D790	180,000 psi
Hardness, ASTM D2240 (Type D)	75-80

MAJOR REVISION DATE MAY 0 1 1990

ECR/N NO. _____

BY WITH CHKD PTF APVD AHC

Change title, add another usage.

CONFIDENTIAL

1. SCOPE

This specification covers polychlorotrifluoroethylene film and sheet products used primarily as gaskets and diaphragm protectors.

2. MATERIAL REFERENCE NO. 1504

Kel-F Film
Lox Grade — omit

Approved Source: omit
J. W. S. Shamban & Company, Part No. S-16892

3. SPECIFICATIONS

(a) Composition: 3M Company's Kel-F resin LOX grade or equivalent.
(b) Form: Film or sheet.
(c) Process: Melt extrusion
(d) Typical physical properties:

Tensile strength @ 73°F, ASTM D638	5725 psi
Elongation at Fail @ 73°F, ASTM D638	150 %
Flexural modulus @ 73°F, ASTM D790	180,000 psi
Hardness, ASTM D2240 (Type D)	75-80

NOV 17 1982

MAJOR REVISION DATE
BY CHKD JWH APVD TKB
BKG. OLD STOCK SCRAP, TRASHED
1 ENGR 1 SAFETY 5 OTHER
1 REMACHINE 2 QUAL 6 COST
1 SCRAP MFG EXPLAIN 3 PURCHASE 7
4 SALES
Revised to current specifications

Kel-F (Lox) Gasket Material FILM AND SHEET				SIZE	TYPE	
FISHER®		BY	DATE	FILE	SUPERSEDES	DW
		AR	1-17-82			FMS 11E9 14-810

CONFIDENTIAL

This laminated plant fiber sheet is a suitable water, gasoline and oil resistant gasket material. It must meet ASTM F104 (F326117-M6).

The following materials have been approved. — delete

1. Vellumoid No. 505 (Federal-Mogul)
2. Fibreflex Detroiter

1. SCOPE

This specification covers treated cellulose fiber sheet suitable for gasketing in water, gasoline and oil service.

2. MATERIAL REFERENCE No.

0401

3. SPECIFICATION

The material shall comply with ASTM F104 F326128-M6

4. TEMPERATURE LIMIT

This material is suitable for continuous service up to +250°F.

5. ACCEPTED SOURCE(S)

(a) Vellumoid, Inc.
Worcester, MA 01606
Style No. Vellumoid 505 Fibre

JUN 08 1989

MAJOR REVISION

ECR/N NO. _____ DATE>
BY WHH CHKD TAG APVD NEK
ENG. ORIG. ISSUE
1 — USE
2 — REWORK
3 — SCRAP/REWORK
4 — SCRAP ITEM
CLASS: 1 — SAFETY, 2 — MAIN, 3 — IMPROVE, 4 — ERROR, 5 — ENVIR, 6 — COST, 7 — PRINTS/SALES
New Format, add HRN, delete Rockwell

©1989

FIBER SHEET GASKET MATERIAL		SIZE	TYPE
C KKM 3-27-89			

FISHER Controls — MARSHALLTOWN, IOWA

	BY	DATE
DWN.	Eyrd	6-26-57
CHKD.	GHS	4-1-80
APVD.	RE	4-1-80

DESIGN
DWG. NO.
REV.

THIS PRINT IS THE PROPERTY OF FISHER GOVERNOR CO.

CONFIDENTIAL

This laminated plant-fiber sheet is a suitable water, gasoline and oil resistant gasket material. It must meet ASTM specification D1170-54T, material Type 3, Number 3211.

The following materials have been approved.

1. Cooper Manufacturing Company "Gaskold"

VELLUMOID. NO. 505 (FEDERAL-MOGUL)

MAJOR REVISION 10-22-79
BY RKB CHKD APVD DATE
FAB. OLD STOCK MOD. REASON
1 — USE 1 — SAFETY 5 — STRGTH
2 — REMACHINE 2 — REALL 6 — COST
3 — SCRAP/REDO 3 — IMPROVE
4 — SCRAP NOW 4 — ERROR
UP-DATE APPROVED MATL
GT. DIXSON

Title: Fiber Sheet Gasket Material

SIZE TYPE

FISHER BY DATE FILE SUPERSEDES

1B

Fisher Controls | Material Specification | FMS 17F3

POLYTETRAFLUOROETHYLENE (PTFE)

Rev: (2) H
By: HM 6-9-88
Apvd: PBB 7-8-76
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1982, (1989) 1991 Revised By: WHH (1-24-89) 8-23-91

1. SCOPE

This specification describes a general purpose PTFE material used in a variety of applications. Most common uses are seat discs, o-rings, seal rings, slides, diaphragm protectors, spacers, bellows, displacers and gaskets.

2. MATERIAL REFERENCE NO. (0624)
0624 oxygen service per FGS 8A11

3. SPECIFICATIONS

(A) Composition: Material composed of virgin, unfilled PTFE (polytetrafluoroethylene), such as DuPont's Teflon 8B. Material should comply with FDA regulations.

(b) Form: Bar, sheet stock or finished shapes.

(c) Process: Compression molded or ram extruded.

4. TYPICAL PROPERTIES

Tensile Strength - ASTM D 1708	(2000-1000 psi)	3700 psi, Minimum
Elongation at fail - ASTM D 1708	(200-100%)	275% , Min.
Hardness - ASTM D 2240 (Type D)	50-55	
Specific Gravity - ASTM D792	2.13 to (2.18)	2.19

AUG 29 1991

MAJOR REVISION DATE

ECR/N NO. BY WHH CHKD PJE APVD NRR

ECR REASON: 1 — SAFETY, 2 — RATE, 3 — IMPROVE, 4 — ERROR, 5 — STOCK, 6 — COST, 7 — MKTG/SALES

OUTLINE: ECR/N, BY, CHKD, APVD, ECR REASON, OBS. OLD STOCK, 1 — DWG, 2 — RECORDS, 3 — PURCHASING, 4 — SCRAP NOW

add oxygen service MSN
change Properties to minimum

Fisher Controls

FISHER

Material Specification

POLYTETRAFLUOROETHYLENE (PTFE)

TFE

No.	FMS 17F3 E
By HW	6-9-48
Appd PBB	7-8-76
Page 1 of 1	
Rev NRP	9-11-84

©Fisher Controls 1982, 1984, 1988

CONFIDENTIAL

1. SCOPE

This specification describes a general purpose PTFE TFE resin material used in a variety of applications. Most common uses are seat discs, o-rings, seal rings, slides, diaphragm protectors, spacers, bellows, displacers and gaskets.

2. MATERIAL REFERENCE NO. 0624

3. SPECIFICATIONS

(a) Composition: Material composed of virgin, unfilled PTFE unfilled TFE Resin (polytetrafluoroethylene).

(b) Form: Bar, sheet stock or finished shapes.

(c) Process: Compression molded or ram extruded.

4. TYPICAL PROPERTIES

Tensile Strength - ASTM D 1708	2000-4000 psi
Elongation at fail - ASTM D 1708	200-400%
Hardness - ASTM D 2240 (Type D)	60-66
Specific Gravity - ASTM D792	2.13 to 2.18

MAJOR REVISION

ECR/N NO. _____ DATE APR 26 1989

BY WHH CHKD DEB APVD NRP

BAD. OLD STOCK
1 X USE
2 __ REVISE
3 __ SCRAP/WITH
4 __ SCRAP NOW

REVISE: BAD. REASON
1 __ SAFETY
2 __ MATL
3 X IMPROVE
4 __ ERROR
5 __ STORE
6 __ COST
7 __ MKTG/SALES

Upgrade nomenclature.

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

TFE CONFIDENTIAL

NO. FMS 17F3-D-C
BY HW 6-7-82
APVD JKB 6-22-82
PAGE 1 OF 2
REV K.C. 8-2-82

TFE
(TETRAFLUOROETHYLENE)

Tensile Strength at 77°F	-	2000-4500 PSI
Elongation at 77°F (In 2 Inches)	-	200-400%
Flexural Strength at 77°F	-	2000 PSI
Hardness	-	50-65 Durometer "D"
Compressive Strength at 0.1% Deformation	-	1700 PSI

1. SCOPE

This specification describes a general purpose TFE resin material used in a variety of applications. Most common uses are seat discs, o-rings, seal rings, shims, diaphragm protectors, spacers, bellows, displacers and gaskets.

2. MATERIAL REFERENCE NO. 0812

3. SPECIFICATIONS

(a) Composition: Material composed of unfilled TFE resin (polytetrafluoroethylene).

(b) Form: Bar, sheet stock or finished shapes.

(c) Process: Compression molded or ram extruded.

(d) Physical Properties:

Tensile Strength -	ASTM D 1708	2000 - 4000 psi
Elongation at fail -	ASTM D 1708	200 - 400 %
Flexural Strength -	ASTM D 790	2000 psi (min)
Hardness -	ASTM D 2240 (Type D)	50-65

APR 1 6 1982

MAJOR REVISION
BY CHKD APVD JKB DATE
REQ. PUR STOCK / REQD. REASON
1 X USE 4 — SAFETY 5 — STOCK
2 — REMACHINE 2 — MATL 6 — OBSOL
3 X IMPROVE 7 — OTHER

TAYLOR V. 3.M. COMPANY ET AL.
ROA_03689

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

TFE CONFIDENTIAL C

NO.	RTS 17F3 B
BY	HWL 6-9-76
APVD	DJC 7-8-76
PAGE	1 OF 1
REV	MS 7-8-76

TFE
(TETRAFLUOROETHYLENE)

Tensile Strength at 77°F	- 2000-4500 PSI
Elongation at 77°F (In 2 Inches)	- 200-400%
Flexural Strength at 77°F	- 2000 PSI
Hardness	- ~~(55-65~~ 50 Durometer "D"
Compressive Strength at 0.1% Deformation	- 1200 PSI

ENGINEERING DEPT. DATE 7-2776
MAJOR REVISION
BY CS CHKD MR APPD PLT
DISPOSITION OF OLD STOCK
UPDATE MATL SPEC

MAJOR REVISION PRINT
DO NOT REMOVE FROM
ENGINEERING FILES

Fisher Controls | Material Specification | FMS 17D32

SPECIAL GRAPHITE ENVIRO-SEAL™ PACKING RING

Rev: A (C)
BY: PEG 7-14-92
Apvd: NFR 7-14-92
Page 1 of 1

FISHER

©Fisher Controls 1992

Revised By:

1. SCOPE

1.1 This specification covers flexible graphite and PTFE composite packing rings used in rotary Enviro-seal™ applications.

1.2 This standard includes reference to the following document:

(a) ASTM D792 Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

2. MATERIAL REFERENCE NO.

011Y

3. SPECIFICATIONS

(a) This packing shall consist of six layers of flexible graphite (Grade GTK Grafoil), each nominally 0.030" thick, alternating with five layers of 0.005" thick PTFE sheet and bonded by hot pressing to achieve a total nominal thickness of 0.205".

(b) Density of the sheet before die cutting rings shall be 78 lb/ft^3 ± 5 lb/ft^3.

(c) The GTK Grafoil shall contain a non-metallic, inorganic, passivating inhibitor for corrosion and oxidation resistance.

(d) Die cut packing ring diameters shall conform dimensionally to the appropriate drawing and shall have a density greater than 85 lb/ft^3 and less than 95 lb/ft^3.

4. DENSITY MEASUREMENT

AUG 18 1997

The density of the ring material shall be measured in a manner similar to ASTM D792, except that the rings shall be coated with a thin film of petroleum jelly prior to weighing. This film prevents penetration of water into the packing rings which would cause erroneous displacement readings.

5. APPROVED SOURCE(S)

(a) Sheet Material
UCAR Carbon Co.
Factory "A"
Cleveland, OH
Grade TG-314

(b) Finished Rings
Cooper Mfg. Co.
Marshalltown, IA
Rings die cut from approved sheet stock.

MAJOR REVISION
ECRN No. 910398 Date 5/6/97
By HLH Chkd [illegible] Apvd TGS

940, Old Stock		930, Reason		
1 ✓ USE	Explain	1 _ SAFETY		6 _ STDZN
2 _ REWORK		2 _ MATL		8 _ COST
3 _ SCRAP/NEW		3 ✓ IMPROVE		7 _ MKTG/ SALES
4 _ SCRAP NOW		4 _ ERROR		

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO

Fisher Controls | Material Specification | (B) FMS 17D31

DIE MOLDED GRAPHITE RIBBON SEAL RING WITHOUT CORROSION INHIBITORS

Rev: (A)
By: BJF 12-10-90
Apvd: NFR 12-11-90
Page 1 of 1

FISHER

*Fisher Controls 1990 | Revised By:

1. SCOPE

This specification establishes a procedure for purchasing, handling and assembly of packing materials which must not contain more than 100 ppm leachable chlorides.

2. PACKING RING MATERIAL REFERENCE NO.

011V

3. CERTIFICATION BY VENDOR

Material must be tested for leachable chloride content per ASTM D512.

4. PACKAGING BY VENDOR

Items must be packaged (one per package) in sealed plastic bags or envelopes that will prevent contamination. Each package must be labeled on the outside that item(s) contained in the package are certified to contain not more than 100 ppm leachable chlorides. The part number(s) and a lot number must also be labeled on the package.

5. HANDLING

All parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limits.

6. DIE MOLDED GRAPHITE RIBBON SEAL RING SPECIFICATIONS

(a) Graphite content 95%.

(b) Packing ring density - 90 lb./ft.^{3} ± 5 lb./ft.^{3}.

(c) Must be made from Union Carbide graphite GTB material.

AUG 18 1997

7. APPROVED SUPPLIERS

(a) Argo Packing Company, Inc.
P. O. Box 66
Oakmont, PA 15139

(b) EGC Enterprises Incorp.
7315 Industrial Parkway
Mentor, OH 44060

MAJOR REVISION
EGRN No. 961398 Date 5/29/97
By HLH Chkd PMD Apvd TOG
B10, Old Stock: 1_USE, 2_REWORK, 3_SCRAP/NEW, 4_SCRAP NOW
B30, Reason: 1_SAFETY, 2_MATL, 3_IMPROVE, 4_ERROR, 5_STDZN, 6_COST, 7_MKTG/SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

TAYLOR V. 3.M. COMPANY ET AL.

Fisher Controls | Material Specification | FMS 17D28

MOLDED COMPOSITION PACKING

Rev: (C) 2
By: WHH 2-17-86
Apvd: NFR 2-17-86
Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls 1986, (1990) 1992 Revised By: WHH (4-5-90) 4-30-92

1. SCOPE

This specification covers molded composition compound for use as valve stem packing. This packing specification was developed to replace molded "graphited asbestos" packings in applications where non-asbestos packings are required.

2. MATERIAL REFERENCE NO. 018T

3. COMPOSITION

Molded plastic ring packing made of synthetic fiber, flake graphite and a small percentage of neoprene binder. The packing shall not contain (any) asbestos in any form. Delete

4. TEMPERATURE RANGE

0°F TO +450°F

5. APPROVED SOURCE(S)

(a) John Crane International
Morton Grove, IL 60053
Style No. 172E

(b) Crane Packing Ltd.
Slough, Berkshire, England
Style No. 9SGAR

MAY 2 7 1992

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD JCK APVD NFR
ADD, OLD STOCK / OBSOL REASON
1 LIST / EXPLAIN: 1 SAFETY 5 STRENGTH
2 REWORK 2 MAIL 6 COST
3 SCRAP/REW 3 PERFORMANCE 7 INTRL/EXTRL SALES
4 SCRAP NOW 4 OTHER

CORRECT GRAMMATICAL ERROR

Fisher Controls	Material Specification	No. FMS 17028	A
FISHER	MOLDED COMPOSITION PACKING	By WHH 2-17-66
	CONFIDENTIAL	Appd NFR 2-17-66
		Page 1 of 1
©Fisher Controls 1966, 1968		Rev

1. SCOPE

This specification covers molded composition compound for use as valve stem packing. This packing specification was developed to replace molded "graphited asbestos" packings in applications where non-asbestos packings are required.

2. MATERIAL REFERENCE NO. 0181

3. COMPOSITION

Molded plastic ring packing made of synthetic fiber, flake graphite and a small percentage of neoprene binder. The packing shall not contain any asbestos in any form.

4. TEMPERATURE RANGE

0°F to +450°F

5. APPROVED SOURCE(S)

(a) John Crane - Houdaille
Morton Grove, Il. 60053
Style No. 177E

(b) Crane Packing Ltd.
Slough, Berkshire, England
Style No. SSGAR

JAN 28 1966

MAJOR REVISION
DATE
BY WHH CHKD RJS APPD NFR

Add additional matl

TAYLOR V. 3.M. COMPANY ET AL.

Fisher Controls | Material Specification | FMS 17D27

FISHER

BRAIDED HIGH TEMPERATURE
N06600 WIRE REINFORCED
COMPOSITION PACKING

Rev: (B) C
By: WHH 2-7-86
Apvd: NFR 2-7-86
Page 1 of 1

CONFIDENTIAL

*Fisher Controls 1986, (1988) 1992

Revised By: WHH (2-2-88) 9-30-92

1. SCOPE

This specification covers composition valve stem packing that is reinforced with totally encapsulated N06600 alloy wire. This packing specification was developed to replace braided "Asbestos-Inconel-Graphite" packings in applications where non-asbestos packings are required.

2. MATERIAL REFERENCE NO. 0188

3. COMPOSITION

Square braided fiber packing containing N06600 wire reinforcing which is totally encapsulated to reduce stem scoring. Packing shall be furnished in ring form with bevel joint. It may contain solid lubricants such as graphite or tungsten disulfide and corrosion inhibiting additives. The packing shall not contain (any) (delete) asbestos in any form.

4. TEMPERATURE RANGE

0°F to + 750°F

5. APPROVED SOURCE(S)

(a) Garlock - Mechanical Packing Div.
Sodus, NY 14551
Style No. 1200-PBI

MAY 2 7 1992

MAJOR REVISION
ECR/N NO. _____ DATE 9-30-92
BY WHH CHKD TJG APVD NFR
BAS. OLD STOCK
ECN REASON
1 _ SAFETY 5 _ STOCK
2 _ WEAR 6 _ COST
3 _ IMPROVE 7 _ DWTG/SPECS
4 _ ERROR
CORRECT GRAMATICAL ERROR

Fisher Controls | Material Specification | FMS 17D26

BRAIDED PTFE-COMPOSITION PACKING

Rev: A (F)
By: WHH 1-22-96
Apvd: NFR 1-22-96
Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls 1986, 1992

Revised By: WHH 4-30-92

1. SCOPE

This specification covers composition valve stem packing impregnated with PTFE (polytetrafluoroethylene). This packing specification was developed to replace FMS 17D8, PTFE - Asbestos packing, for applications where non-asbestos packings are required.

2. MATERIAL REFERENCE NO. 018N

3. COMPOSITION

Square braided fiber packing impregnated with PTFE dispersion and furnished in ring form with bevel joint. It may contain a small amount of break-in lubricant. The packing shall not contain asbestos in any form.

3.1 Packing should be reasonably clean and free from graphite.

4. TEMPERATURE RANGE

-100°F to 450°F

5. RESTRICTIONS

Packing should not be used for oxygen service. Packing should not be used outside pH range of 3 to 12.

6. APPROVED SOURCES

(a) Garlock-Mechanical Packing Div.
Sodus, NY 14551
Style No. 8922

(b) John Crane International
Morton Grove, IL 60053
Style No. K1760

(c) Crane Packing Ltd.
Slough, Berkshire, England
Style No. 20AR

AUG 18 1997

MAJOR REVISION
ECRN No. 961398 Date 5/7/97
By HLH Chkd PhD Apvd JDG

840, Old Stock
1 _ USE
2 _ REWORK
3 _ SCRAP/NEW
4 _ SCRAP NOW

800, Reason
1 _ SAFETY 5 _ STDZN
2 _ MATL 6 _ COST
3 _ APPROVE 7 _ MKTG/
4 _ ERROR SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | FMS 17D2

BRAIDED PTFE-COMPOSITION PACKING

Rev: (A)
By: WHH 1-22-86
Apvd: NFR 1-22-86
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1986, (1988) 1990 Revised By: WHH 1-14-88

1. SCOPE

This specification covers composition valve stem packing impregnated with PTFE (polytetrafluoroethylene). This packing specification was developed to replace FMS 17D8 for applications where non-asbestos packings are required.

2. MATERIAL REFERENCE NO. 018N

3. COMPOSITION

Square braided fiber packing impregnated with PTFE dispersion and furnished in ring form with bevel joint. It may contain a small amount of break-in lubricant. The packing shall not contain any asbestos in any form.

3.1 Packing should be reasonably clean and free from graphite.

4. TEMPERATURE RANGE

-100°F to 450°F

5. RESTRICTIONS

Packing should not be used for oxygen service. Packing should not be used outside pH range of 1 to 12.

6. APPROVED SOURCES

(a) Garlock-Mechanical Packing Div.
Sodus, NY 14551
Style No. 8922

(b) John Crane-Houdaille ~~Garlock~~ International
Morton Grove, IL 60053
Style No. KI760

(c) Crane Packing Ltd.
Slough, Berkshire, England
Style No. 20AR

APR 18 1990

MAJOR REVISION

ECR/N NO. _____ DATE

BY WHA CHKD DRB APVD NFR

Update name of vendor

FMS2-12/1

Fisher Controls	Material Specification	No. FNS. 17025	C
FISHER	SQUARE BRAIDED ASBESTOS - GRAPHITE PACKING WITH INCONEL WIRE CONFIDENTIAL	BY WHH 11-11-85 APP'D [illegible] 11-11-85 Page 1 of 1	
©Fisher Controls 1985		Rev	

1. SCOPE

OBSOLETE

This specification covers an asbestos, Inconel, graphite compound for use as high temperature valve stem packing.

2. MATERIAL REFERENCE NO. 019K

3. COMPOSITION

Manufactured in square cross section by braiding an Inconel wire inserted, AAA grade asbestos jacket over a high temperature resistant asbestos graphite core. The packing is treated with a corrosion inhibitor and given a surface treatment of dry type lubricant and graphite.

4. TEMPERATURE RANGE

0 to +750°F

5. APPROVED SOURCE

Argo Packing Co.
P.O. Box 66
Oakmont, PA 15139
Style No. 615

MAJOR REVISION APR 22 1987
ECR/N NO. _____ DATE
BY WHH CHKD DCR APVD NTR
440. OLD STOCK 439. REASON
1 ISSUE 1 SAFETY 5 STDZN
2 REORDER 2 USEFUL 6 COST
3 SCRAP/ENTRY 3 IMPROVE 7 MKTG/
4 SCRAP NOW 4 ERROR SALES
with 9-30-87 then scrap

Obsolete, see none
Asbestos elimination program

Fisher Controls | Material Specification | FMS 17D24

25% CARBON FILLED PTFE PACKING

Rev: X (E)
By: HLH 9-14-81
Apvd: BR 9-14-81
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1981, 1991

Revised By: WBH 8-23-91

1. SCOPE

This specification covers 25% carbon filled PTFE adaptor rings for use as an antistatic device for rotary valves.

2. MATERIAL REFERENCE NO. 019V

3. SPECIFICATIONS

Composition: 25% carbon filled PTFE (by weight)

Electrical Surface Resistivity: ASTM D257: 15,000 ohms Maximum

4. TEMPERATURE RANGE

-40° F to +450° F

5. APPROVED SOURCES

(a) John Crane International
Norton Grove, IL 60053

(b) Norton Performance Plastics
Elk Grove, IL 60007

MAJOR REVISION
ECRN No. 46398 Date 5/20/97
By HLH Chkd PMD Apvd TDG
840, Old Stock
1 _ REUSE
2 _ REWORK
3 _ SCRAP/NEW
4 _ SCRAP NOW
030, Rodson
1 _ SAFETY
2 _ MATL
3 _ IMPROVE
4 _ ERROR
6 _ STDZN
6 _ COST
7 _ MKTG/SALES

AUG 18 1997

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc, were to accommodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls

FISHER

Material Specification

PTFE

25% CARBON FILLED (TFE) PACKING

No. FMS 17D24 B

By HBP 9-14-81

Appd BR 9-14-81

Page 1 of 1

©Fisher Controls 1981 (1983)

Rev NBP 10-13-93

CONFIDENTIAL

1. SCOPE

This specification covers 25% carbon filled (PTFE) adaptor rings for use as an antistatic device for rotary valves.

2. MATERIAL REFERENCE NO. 019V

3. SPECIFICATIONS

Composition: 25% carbon filled (PTFE) (by weight)

Electrical Surface resistivity: ASTM D257: 15,000 ohms maximum

4. APPROVED SOURCES

John Crane, Halogen or Equivalent.

4. TEMPERATURE RANGE

-40°F to +450°F

MAJOR REVISION

ECR/II NO. _____ DATE APR 22 1987

BY WJH CHKD DeB APVD AHS

Standardize mat'l. description

Add temp. range

Fisher Controls	Material Specification	No. FMS 17022	C
FISHER	GRAPHITE FILAMENT YARN - LOW CHLORIDE (CERTIFIED LESS THAN 100 PPM) CONFIDENTIAL	By LLB 9-27-79	
		Appd ENER 9-27-79	
		Page 1 of 1	
©Fisher Controls 1986		Rev NRP 9-19-86	

1. SCOPE

OBSOLETE

This specification covers low chloride square braided graphite filament packing for use as valve stem packing usually in conjunction with laminated graphite packing rings.

2. MATERIAL REF. NO. - D195

3. SPECIFICATIONS

Graphite Content---------- 99%
Chloride Content---------- 100 PPM Maximum at 1000°F

4. CERTIFICATION BY VENDOR

Items purchased to this specification must be tested for leachable chloride per ASTM D512-67. The items must also be manufactured, processed and packaged in a manner which will justify certification.
Each order must be certified that the requirements have been met.

5. PACKAGING BY VENDOR

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

6. HANDLING AND ASSEMBLY BY FISHER

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

7. APPROVED SOURCES

(a) Norton/Chemplast
150 Dey Rd.
Wayne, NJ 07470
Style No. 2000

(b) John Crane - Houdaille, Inc.
6400 Oakton St.
Morton Grove, IL 60053
Style No. 1626GF

OBSOLETE SUPERSEDED BY DWG. No. FMS 17019

MAJOR REVISION
ECR/M NO. _____ DATE FEB 27 1987
BY bvhf CHKD RLT APVD NRP

New covered in FMS 17019

TAYLOR V. 3.M. COMPANY ET AL.
ROA_03701

10-2-79

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE FILAMENT YARN - LOW CHLORIDE
(CERTIFIED LESS THAN 100 PPM)

NO. FMS 17022
BY PRG 9-27-79
APVD [illegible] 9-27-79
PAGE 1 OF 1
REV N C

1. SCOPE

This specification covers low chloride square braided graphite filament packing for use as valve stem packing usually in conjunction with laminated graphite packing rings.

CONFIDENTIAL

2. Material Ref. No. - 0198

3. Specifications

Graphite Content ---------- 99%
Chloride Content ---------- 100 PPM Maximum at 2000°F

4. Certification by Vendor

Items purchased to this specification must be tested for leachable chloride per ASTM D512-67. The items must also be manufactured, processed and packaged in a manner which will justify certification.
Each order must be certified that the requirements have been met.

5. Packaging by Vendor

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

6. Handling and Assembly by Fisher

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

7. Approved Sources

Accepted Type:

(a) Chemplast Style 2000
Chemplast, Inc.
26 Quince St.
Cranford N.J. 07016

Norton/Chemplast
150 Day Rd.
Wayne, New Jersey 07470
Style No. 2000

(b) Crane Style 1625GF
Crane Packing Co.
6400 Oakton St.
Morton Grove, Ill. 60053

John Crane - Houdaille, Inc.
6400 Oakton St.
Morton Grove, IL 60053
Style No. 1625GF

MAJOR REVISION
ECR/N NO. _____ DATE
BY NPP CHKD WHH APVD WPR
BAS. ON STOCK / 1% USE / 2 REWORK / 3 SCRAP/NEW / 4 SCRAP NOW
REASON: 1 SAFETY / 2 MAIL / 3 IMPROVE / 4 ECREDR / 5 SUPER / 6 COST / 7 MKTG/SALES
SPECIFICATION INACTIVATED BY CUSTOMER
RE-ACTIVATE & UPDATE FORMATS

Fisher Controls	Material Specification	No. FMS 17021 B1
FISHER	GRAPHITE LAMINATE PACKING WITH SACRIFICIAL ZINC WASHER - LOW CHLORIDE (CERTIFIED LESS THAN 100 PPM)	By LLB 9-27-79
		Appd EITER 9-27-79
		Page 2 of 2
©Fisher Controls 1986		Rev NRP 9-19-86

7. APPROVED SOURCE(S)

OBSOLETE CONFIDENTIAL

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil Grade GTN

OBSOLETE
SUPERSEDED BY
FMS 17017
MRN 019A

JAN 05 1988

MAJOR REVISION
ECR/N NO. A9440 DATE
BY RLZ CHKD WHITE APVD NEC

Obsolete

10-2-79

Fisher Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE LAMINATE PACKING WITH SACRIFICIAL ZINC WASHER - LOW CHLORIDE (CERTIFIED LESS THAN 100 PPM)

FMS-17D22 B

BY [illegible] 9-27-79

APVD [illegible] 9-27-79

PAGE 1 OF 1

REV N

1. SCOPE

This specification covers laminated graphite packing for use as valve stem packing usually in conjunction with braided graphite filament end rings. C

CONFIDENTIAL

2. Material Ref. No. - 019R

3. SPECIFICATIONS

Packing shall consist of a laminated graphite packing ring with one .004 thick sacrificial washer packaged with each ring of packing.

(a) Laminated Graphite Specifications

Graphite Content ---------- 99%
Density ---------- 70 LB/FT^3
Certified leachable chloride content 100 PPM maximum.
Lamination perpendicular to shaft.

(b) Sacrificial Washer Specification

Material - Zinc ASTM B69 or Equivalent
Nominal Thickness - .004"
Nominal I.D. = Packing Ring I.D. + 1/8 in.
Nominal O.D. = Packing Ring O.D. - 1/16 in.
Washer may be split to ease installation.

4. Certification By Vendor

Items purchased to this specification must be tested for leachable chloride per ASTM D512-67. The items must also be manufactured, processed and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

5. Packaging by Vendor

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

6. Handling and Assembly by Fisher

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain chloride content within specified limit when certification is required by customer specification.

APPROVED SOURCE(S)

7. Accepted Type:
Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil Grade GTN

MAJOR REVISION

ECR/N NO: ---------- DATE:
BY NPP CHKD [illegible] APVD [illegible]

ADD OLD STOCK		NEW REASON	
1 X USE	CHECK	1 SAFETY	5 SUPPLY
2 REWORK		2 MAIL	6 COST
3 SCRAP/REW.		3 IMPROVE	7 MKTG/
4 SCRAP/NEW		4 X ERROR	SALES

NEW SPECIFICATIONS INITIATED
BY MERGE, REACTIVATE & UPDATE FORMAT

TAYLOR V. 3.M. COMPANY ET AL.

FISHER Control
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE LAMINATE PACKING
HIGH DENSITY - LOW CHLORIDE
WITH SACRIFICIAL ZINC WASHER

NO. FMS 17D20 B
BY JHS 6-15-78
APVD [illegible] 6-16-78
PAGE 1 OF 1
REV [illegible] 2-27-80

C

OBSOLETE CONFIDENTIAL

Material Reference No. 019P

Packing shall consist of a laminated graphite packing ring with one .004 thick sacrificial washer packaged with each ring of packing.

CERTIFICATION, PACKING AND ASSEMBLY REQUIRED PER FMS 17D16 . . . . . .

Laminated Graphite Specifications

Graphite Content ———— 99%
Density ———— 105 LB/FT^3
Certified Leachable chloride content 200 PPM maximum
Lamination perpendicular to shaft.

Sacrificial Washer Specification

Material - Zinc ASTM B69 or equivalent
Nominal Thickness = .004
Nominal I.D. = Packing Ring I.D. + 1/8 in.
Nominal O.D. = Packing Ring O.D. - 1/16 in.
Washer may be split to ease installation.

OBSOLETE
SUPERSEDED BY
FMS 17D17
MRH 019P

Approved Material:

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil

JAN 0 5 1988

MAJOR REVISION
ECR/R NO. 4940 DATE
BY RLT CHKD WHB APVD VEA

Obsolete

BRAIDED GRAPHITE FILAMENT PACKING WITH LOW IMPURITIES

FISHER

Rev: 1
By: [illegible] 2-8-77
Apprd: KC 2-16-77
Page: 2 of 3

Fisher Controls 1982, 1985

Revised By: [illegible] 6-13-85

(c) Yarns used to construct the braided outer jacket shall be composed of continuous graphite filament.

(d) The braided filament packing shall not contain any adhesive.

4. GENERAL USAGE OF BRAIDED GRAPHITE FILAMENT PACKING RINGS

These packing rings shall be suitable for general purpose usage as axial-extrusion and valve stem wiper rings in conjunction with graphite packing seal rings. They shall also be suitable for use in the petroleum, fossil and nuclear fueled power generation, chemical, and general process type industries. They must also be suitable for use at temperatures up to 700° F in oxidizing environments and from 700° F to 1000° F in non-oxidizing environments.

5. CERTIFICATION BY VENDOR

The packing must be manufactured, processed and handled in a manner that will allow certification. When certification is specified on the purchase order, the lot of packing material must be tested for the elements listed in 3 (a) above. A copy of the chemical analysis must accompany each individual order and/or package when certification is specified.

6. PACKAGING BY VENDOR

Packing rings must be individually packaged in sealed plastic bags or envelopes which will prevent contamination. All packing must be labeled with the date of manufacture.

7. HANDLING AND ASSEMBLY

All packing made to conform to this specification shall be handled in a manner that will maintain low impurity content as required.

8. QUALITY

The manufacturer of the packing shall be required to guarantee: (1) dimensional compliance to appropriate Fisher drawings and 42) compliance to this specification.

9. APPROVED SOURCES

(a) NOR, Inc.
1801 Main St.
Shrewsbury, PA 17361
(412) 784-8415
Nor-Seal Style 8524 Nuclear Graphite Filament Yarn Packing

(b) John Crane International
5425 Willow Creek Dr. SW
Cedar Rapids, IA 52404
(319) 364-5176
Style 1XNSG Nuclear Service Graphite Filament Yarn Packing

FISHER

BRAIDED GRAPHITE FILAMENT PACKING WITH LOW CHLORIDES AND PTFE LUBRICATION

Rev: 1
By: [illegible] 2-8-77
Apprd: KC 2-16-77
Page: 3 of 3

Fisher Controls 1982, 1985

Revised By: TDG 5-2-86

8. QUALITY

The manufacturer of the packing shall be required to guarantee:
1. dimensional compliance to appropriate Fisher drawings and
2. compliance to this specification.

9. APPROVED SOURCES

(a) Argo Packing Company
Oakmont, PA 15139
Packing Style 525

MAJOR REVISION Date> 5-7-86
See Cover Sheet Revision
1 to 5
for change information

CONFIDENTIAL

*Fisher Controls 1982, 1989 Revised By: WHH 6-1-89

7. HANDLING AND ASSEMBLY

All packing made to conform to this specification shall be handled in a manner that will maintain low chloride content as required by the particular application.

8. QUALITY

The manufacturer of the packing shall be required to guarantee, (1) dimensional compliance to appropriate Fisher drawings and (2) compliance to this specification.

9. APPROVED SOURCES

(a) Argo Packing Company
Oakmont, Pennsylvania 15139
(packing style 525)

MAY 02 1991

MINOR CHANGE
BY WHH CHKD. BY DRR
DATE ENGINEERING DEPT.
correct spelling

Fisher Controls | Material Specification | FMS 17D1

BRAIDED GRAPHITE FILAMENT PACKING
WITH Low Impurities

REV: 5M
By: EE 2-9-77
Apvd: RZ 2-16-77
Page 1 of 2

FISHER

99 CONFIDENTIAL

©Fisher Controls 1982, 1989

Revised By: ~~WHH~~ ~~89~~
TOG 6-7-94

1. SCOPE

This specification covers braided graphite filament packing for use as valve stem packing, usually in conjunction with laminated or ribbon graphite packing rings.

1.1 This specification includes reference to the following document:

2. MATERIAL REFERENCE NOS.

(a) General Chemical 080 Type, Low Impurity Graphite Filament Packing, Meeting Reduced Impurity Limits.

~~0190 Low Chloride Packing~~

~~0198 Packing Certified to less than 100 ppm leachable chloride~~

Certified Low Impurity Graphite Filament Packing

3. SPECIFICATIONS

These impurities shall not exceed limits in GCS Document and be tested by ~~ASTM D512~~

(a) ~~Leachable chloride content shall not exceed 100 ppm.~~

(b) The braided filament packing shall exhibit less than 25% weight loss when samples are subjected to a 1200° F. nitrogen environment for three and one half hours.

(c) Yarns used to construct the braided outer jacket shall be composed of continuous graphite filament.

(d) The braided filament packing shall not contain any asbestos.

4. GENERAL USAGE OF BRAIDED GRAPHITE FILAMENT PACKING RINGS

These packing rings shall be suitable for general purpose usage as effective extrusion and valve stem wiper rings in conjunction with graphite packing seal rings. They shall also be suitable for use in the petroleum, power generation, chemical; and general process type industries. They must also be suitable for use at temperatures up to 700° F. in oxidizing environments and from 700° F. to 1000° F. in non-oxidizing environments.

5. CERTIFICATION BY VENDOR

When certification is required, the packing lot must be tested for leachable chloride content per ASTM-D512. The packing must be manufactured, processed, and handled in a manner that will allow certification.

Copy of chemical analysis must be accompany each individual order and/or package when certification is specified on the packing order.

6. PACKAGING BY VENDOR

Packing rings must be individually packaged in sealed plastic bags or envelopes which will prevent contamination. ~~Certified low chloride packing must be labeled as such.~~ All packing must be labeled with the date of manufacture.

MAJOR REVISION
ENGR'G NO. 440911 DATE 6-10-94
BY TOG CHKD DRB APVD JLC
JUN 14 1994

FMSI-10/1

INCLUDED PROHIBITIONS OF HALOGENS, NITRATES, NITRITES, SULFUR, LEACHING METALS.

BRAIDED GRAPHITE FILAMENT PACKING

REV: (F) G
By: ES 2-9-77
Apvd: RZ 2-16-77
Page 1 of 2

FISHER

CONFIDENTIAL

©Fisher Controls 1982, (1987) 1989 Revised By:

1. SCOPE

This specification covers braided graphite filament packing for use as valve stem packing, usually in conjunction with laminated or ribbon graphite packing rings.

2. MATERIAL REFERENCE NOS.

0190 Low Chloride Packing
0198 Packing Certified to less than 100 ppm leachable chloride

3. SPECIFICATIONS

(a) Leachable chloride content shall not exceed 100 ppm.

(b) The braided filament packing shall exhibit less than 25% weight loss when samples are subjected to a 1200° F. nitrogen environment for three and one half hours.

(c) Yarns used to construct the braided outer jacket shall be composed of continuous graphite filament.

(d) The braided filament packing shall not contain any asbestos.

4. GENERAL USAGE OF BRAIDED GRAPHITE FILAMENT PACKING RINGS

These packing rings shall be suitable for general purpose usage as anti extrusion and valve stem wiper rings in conjunction with graphite packing seal rings. They shall also be suitable for use in the petroleum, power generation, chemical, and general process type industries. They must also be suitable for use at temperatures up to 700° F. in oxidizing environments and from 700° F. to (1200°) F. in non-oxidizing environments.

5. CERTIFICATION BY VENDOR

When certification is required, the packing must be tested for leachable chloride content per ASTM D512. The packing must be manufactured, processed, and handled in a manner that will allow certification.

6. PACKAGING BY VENDOR

Packing rings must be individually packaged in sealed plastic bags or envelopes which will prevent contamination. Certified low chloride packing must be labeled as such. All packing must be labeled with the date of manufacture.

MAJOR REVISION
ECR/N NO. _____ DATE JUN 05 1989
BY WNH CHKD TOS APVD NFR
REQ. OLD STOCK 1 CUSTOMER 5 OTHER
2 REPAIR 2 SAFETY 6 COST
3 OBSOLESCENCE 3 IMPROVE 7 USING SAME
4 SCRAP NOW 4 ERROR
Rhenea max. acc. form.

Fisher Controls | Material Specification

FISHER

BRAIDED GRAPHITE FILAMENT PACKING

CONFIDENTIAL

Dig. FNS 17019 E
By E.E. 2-9-77
Appd B.Z. 2-16-77
Page 1 of 2

©Fisher Controls 1982, 1987

App B.Y. 5-7-87

1. SCOPE

This specification covers braided graphite filament packing for use as valve stem packing, usually in conjunction with laminated or ribbon graphite packing rings.

MAJOR REVISION OCT 08 1987
ECR/N NO. A8557 DATE>
BY R.F. CHKD MWH APVD NFR
ADD, OBS STOCK / ECO, REASON
1 — USE / 1 — SAFETY / 5 — SERVICE
2 — REWORK / 2 — FAIL / 6 — COST
3 — SCRAP/NEW / 3 — IMPROVE / 7 — MKTG/SALES
4 — SCRAP NOW / 4 — ERROR
EXPLAIN

2. MATERIAL REFERENCE NOS.

0190 Low Chloride Packing
0195 Packing Certified to less than 100 ppm leachable chloride

3. SPECIFICATIONS

Deleted One supplier

(a) Leachable chloride content shall not exceed 100 ppm.

(b) The braided filament packing shall exhibit less than 25% weight loss when samples are subjected to a 1200° F. nitrogen environment for three and one half hours.

(c) Yarns used to construct the braided outer jacket shall be composed of continuous graphite filament.

(d) The braided filament packing shall not contain any asbestos.

4. GENERAL USAGE OF BRAIDED GRAPHITE FILAMENT PACKING RINGS

These packing rings shall be suitable for general purpose usage as anti extrusion and valve stem wiper rings in conjunction with graphite packing seal rings. They shall also be suitable for use in the petroleum, power generation, chemical, and general process type industries. They must also be suitable for use at temperatures up to 700° F. in oxidizing environments and from 700° F. to 1200° F. in non-oxidizing environments.

5. CERTIFICATION BY VENDOR

When certification is required, the packing must be tested for leachable chloride content per ASTM D512. The packing must be manufactured, processed, and handled in a manner that will allow certification.

6. PACKAGING BY VENDOR

Packing rings must be individually packaged in sealed plastic bags or envelopes which will prevent contamination. Certified low chloride packing must be labeled as such. All packing must be labeled with the date of manufacture.

Fisher Controls	General Specification	No. FMS 17019	
FISHER	BRAIDED GRAPHITE FILAMENT PACKING CONFIDENTIAL	By EE	2-9-77
		Appd. RB	2-10-77
		Page 1 of 2	
©Fisher Controls 1982, 1987		Rev. R17	2-17-87

E

1. SCOPE

This specification covers braided graphite filament packing for use as valve stem packing, usually in conjunction with laminated or ribbon graphite packing rings.

MAJOR REVISION MAY 1 8 198

ECR/N NO. _____ DATED

BY RLB CHKD WHH LEVD NFE

ADD 2ND SOURCE

2. MATERIAL REFERENCE NOS.

0190 Low Chloride Packing
0195 Packing Certified to less than 100 ppm leachable chloride

3. SPECIFICATIONS

(a) Leachable chloride content shall not exceed 100 ppm.

(b) The braided filament packing shall exhibit less than 25% weight loss when samples are subjected to a 1200° F. nitrogen environment for three and one half hours.

(c) Yarns used to construct the braided outer jacket shall be composed of continuous graphite filament.

(d) The braided filament packing shall not contain any asbestos.

4. GENERAL USAGE OF BRAIDED GRAPHITE FILAMENT PACKING RINGS

These packing rings shall be suitable for general purpose usage as anti-extrusion and valve stem wiper rings in conjunction with graphite packing seal rings. They shall also be suitable for use in the petroleum, power generation, chemical, and general process type industries. They must also be suitable for use at temperatures up to 700° F. in oxidizing environments and from 700° F. to 1200° F. in non-oxidizing environments.

5. CERTIFICATION BY VENDOR

When certification is required, the packing must be tested for leachable chloride content per ASTM D512. The packing must be manufactured, processed, and handled in a manner that will allow certification.

6. PACKAGING BY VENDOR

Packing rings must be individually packaged in sealed plastic bags or envelopes which will prevent contamination. Certified low chloride packing must be labeled as such. All packing must be labeled with the date of manufacture.

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION
CONFIDENTIAL

GRAPHITE FILAMENT YARN
- LOW CHLORIDE

NO. FMS 17D19, 18
BY EE 2-9-77
APVD [illegible] 2-9-77
PAGE 1 OF 1
REV B16 4-27-77

Material Reference No. 0190

Certification, Packing and Assembly Required Per FMS 17D16

Specifications

Graphite Content ---------- 99%
Chloride Content ---------- 200 PPM Maximum at 1,000 °F

Accepted Type:

Chempro Style 2000
Chempro, Inc.
16 Quincy St
Cranford N.J. 07016

Crane Style 1625GF
Crane Packing Co.
6400 Oakton St.
Morton Grove, Ill. 60053

omit

APR 14 1982

4-5-82 date

MAJOR REVISION
BY [illegible] CHKD [illegible] APVD IKB
840. OLD STOCK 836. REASON
3 ASSE 1 — SAFETY 5 — SPEC
2 — REMACHINE 2 — MATL 6 — CUST
3 — SCRAP/REW 3 — IMPROVE 7 — D 3/
4 — SCRAP MTL 4 — ERROR 8 — S

Update to new format

1. SCOPE

This specification covers square braided graphite filament packing for use as valve stem packing usually in conjunction with laminated graphite packing rings.

2. MATERIAL REFERENCE NO. 0190

3. SPECIFICATIONS

(a) Graphite content - 99% min.
(b) Chloride content - 200 ppm max. at 1000°F

4. SPECIAL HANDLING

Certification, packaging, handling and assembling required per FMS 17D16

5. APPROVED SOURCES

(a) Chemplast, Inc.
Seal and Packing Div.
Clark, NJ 07066

(b) Crane Packing Co.
Mechanical Packing Div.
Morton Grove, IL 60053

FISHER Control's
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE LAMINATE PACKING
HIGH DENSITY - LOW CHLORIDE

NO. FMS 17D18 (B)
BY EE 2-9-77
APVD GR 2-16-77
PAGE 1 OF 1
REV JHS 6-16-85

Material Reference No. 019H

OBSOLETE CONFIDENTIAL

CERTIFICATION, PACKING AND ASSEMBLY REQUIRED PER FMS 17D16

Laminated Graphite Specifications

Graphite Content ——— 99%
Density ——— 105 LB/FT^3
Certified leachable chloride content 200 PPM maximum.
Lamination perpendicular to shaft.

OBSOLETE
SUPERSEDED BY
FMS 17D17
MRN 019H

Approved Material

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil

JAN 05 1988

MAJOR REVISION
ECR/N NO. A9440 DATE
BY RLZ CHKD JWH APVD NFR

Obsolete

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

CHAPELITE LAMINATE PACKING
HIGH DENSITY - LOW CHLORIDE

NO. FMS 17D18 (B)
BY EE 2-9-77
APVD [illegible] 2-16-77
PAGE 1 OF 1
REV JHS 1-30-79

Material Reference No. 019E

CONFIDENTIAL

CERTIFICATION, PACKING AND ASSEMBLY REQUIRED PER FMS 17D16

Laminated Graphite Specifications

Graphite Content ----------99%
Density ----------105 LB/FT^3
Certified Leachable chloride content 200 PPM maximum.
Lamination perpendicular to shaft.

Approved Material:

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil

SACRIFICIAL WASHER SPECIFICATION:
MATERIAL - ZINC ASTM B69 OR EQUIVALENT
NOMINAL THICKNESS = .004
NOMINAL I.D. = PACKING RING I.D. + 1/8 IN.
NOMINAL O.D. = PACKING RING O.D. - 1/16 IN.
WASHER MAY BE SPLIT TO EASE INSTALLATION

MAJOR REVISION 6-5-78 DATE
BY [illegible] CHKD JHS APVD [illegible]
840. OLD STOCK 430. REASON
1 X USE 1 — SAFETY 5 — OTHER
2 — REMACHINE 2 — MAFL 6 — OTHER
3 — SCRAP/REVR EXPLAIN 3 X IMPROVE
4 — SCRAP NOW 4 — ERROR
NEED CLOSER CONTROL OF ZINC RINGS

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE LAMINATE PACKING
HIGH DENSITY - LOW CHLORIDE

NO. FMS 17D16	B
BY EE	2-8-77
APVD	2-16-77
PAGE 1 OF 1	
REV WDH	6-13-77

Material Reference No. 019H

CONFIDENTIAL

CERTIFICATION, PACKING AND ASSEMBLY REQUIRED PER FMS 17D16

Laminated Graphite Specifications

Graphite Content ---------- 99%
Density ---------- 105 LB/FT3
Certified leachable chloride content 200 PPM maximum at 1000°F.
Lamination perpendicular to shaft.

Approved Material:

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil

MAJOR REVISION 10-3-77
BY EE CHKD RTL APVD RTL DATE
U.S. MFG STOCK
DISPOSE
REVIEW
FROM
DETAIL
REV. REASON
1 SAFETY 5 STORE
2 WEAR 6
3
4
REASON: clarification

FISHER

*Fisher Controls 1976, 1991

Revised By: WHH 10-10-91

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling and assembly of packing materials which must not contain more than 100 parts per million leachable chlorides.

2. CERTIFICATION BY VENDOR

Material must be tested for leachable chloride content per ASTM D512.

3. PACKAGING BY VENDOR

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination. Each bag or envelope must be labeled on the outside that each item is certified to contain not more than 100 parts per million leachable chloride content.

4. HANDLING AND ASSEMBLY

All parts made to confrom to this specification shall be handled in a manner that will maintain chloride content within specified limits.

5. LAMINATED GRAPHITE PACKING RING (OR ASSEMBLY) SPECIFICATIONS

(a) Laminations perpendicular to shaft
(b) Graphite content——————99% minimum
(c) Packing ring density—see following table
(d) Zinc washers—see following table

(1) Material-Zinc ASTM B69 or Equivalent
(2) Nominal Thickness = 0.004 Inches
(3) Nominal I.D. = Packing Ring I.D. + 1/16 Inch
(4) Nominal O.D. = Packing Ring O.D. - 1/32 Inch
(5) Washer may be split to ease installation
(6) When zinc rings are required one zinc ring must with each graphite packing ring

MAJOR REVISION
ECRN No. 91-1398 Date 5/21/91
By HH Chkd PMD Apvd TDS

AUG 18 1997

640-Obl Stock
1 USE
2 REWORK
3 SCRAP NEW
4 SCRAP NOW

Explain:
BSD, Rosson
1 SAFETY
2 MATL
3 IMPROVE
4 ERROR
5 STDZN
6 COST
7 MKTG
SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | FMS 17D17

GRAPHITE LAMINATE PACKING | Rev: (E) G
By: RDH 6-15-76
Apvd: RTW 9-10-76
Page 1 of 2

FISHER

CONFIDENTIAL

*Fisher Controls 1976, 1991

Revised By: MW 4-30-91
10-10-91

1. SCOPE

This specification establishes a procedure for purchasing, handling and assembly of packing materials which must not contain more than 100 parts per million leachable chlorides.

2. CERTIFICATION BY VENDOR

Material must be tested for leachable chloride content per ASTM D512.

3. PACKAGING BY VENDOR

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination. Each bag or envelope must be labeled on the outside that each item is certified to contain not more than 100 parts per million leachable chloride content.

4. HANDLING AND ASSEMBLY

All parts made to confrom to this specification shall be handled in a manner that will maintain chloride content within specified limits.

5. LAMINATED GRAPHITE PACKING RING (OR ASSEMBLY) SPECIFICATIONS

(a) Laminations perpendicular to shaft
(b) Graphite content ~~99%~~ 95% minimum
(c) Packing ring density—see following table
(d) Zinc washers—see following table

(1) Material-Zinc ASTM B69 or Equivalent
(2) Nominal Thickness = 0.004 Inches
(3) Nominal I.D. = Packing Ring I.D. + 1/16 Inch
(4) Nominal O.D. = Packing Ring O.D. - 1/32 Inch
(5) Washer may be split to ease installation
(6) When zinc rings are required one zinc ring must be packaged with each graphite packing ring.

OCT 30 1991

MAJOR REVISION

ECR/N NO. _____ DATE 10-2
BY WHH CHKD TGT APVD _____
0=NO, OLD STOCK 1=USE 2=REVISE 3=RECLASSIFY 4=SCRAP NOW
REASON: 1=ENG 2=MFG 3=PURCHASE 4=ERROR 5=STOCK 6=COST 7=MKTG/SALES
Change min. graphite content, update vendor name.

Fisher Controls | Material Specification | FMS 17D17

GRAPHITE LAMINATE PACKING

FISHER

CONFIDENTIAL

Rev: E
By: WDS 6-15-76
Apvd: RHW 9-10-76
Page 1 of 2

©Fisher Controls 1976, 1987, 1991 | Revised By: BJ 12-7-87 WHH 4-30-91

1. SCOPE

This specification establishes a procedure for purchasing, handling and assembly of packing materials which must not contain more than 100 parts per million leachable chlorides.

2. CERTIFICATION BY VENDOR

Material must be tested for leachable chloride content per ASTM D512.

3. PACKAGING BY VENDOR

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination. Each bag or envelope must be labeled on the outside that each items is certified to contain not more than 100 parts per million leachable chloride content.

4. HANDLING AND ASSEMBLY

All parts made to confrom to this specification shall be handled in a manner that will maintain chloride content within specified limits.

5. LAMINATED GRAPHITE PACKING RING (OR ASSEMBLY) SPECIFICATIONS

(a) Laminations perpendicular to shaft
(b) Graphite content——————99%
(c) Packing Ring Density—see following table
(d) Zinc Washers—see following table

(1) Material-Zinc ASTM B69 or Equivalent
(2) Nominal Thickness = 0.004 Inches
(3) Nominal I.D. = Packing Ring I.D. + 1/16 Inch
(4) Nominal O.D. = Packing Ring O.D. - 1/16 Inch
(5) Washer may be split to ease Installation
(6) When zinc rings are required one zinc ring must be packaged with each graphite packing ring

1/16
1/32

MAY 24 1991

MAJOR REVISION

ECR/B NO. _____ DATE

BY WHH CHKD DSB APVD NFS

ENG. OLD STOCK
1 USE
2 REWORK
3 SCRAP/REW.
4 SCRAP NOW

EXPLAIN

ENG. REASON
1 SAFETY
2 MATL
3 IMPROVE
4 ERROR
5 STOCK
6 COST
7 SERVI/ SALES

Change tolerances on Zinc Washer

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE LAMINATE PACKING WITH SACRIFICIAL ZINC WASHER - LOW CHLORIDE

NO. FMS 17017
BY WDH 6-15-76
APVD RTW 9-10-76
PAGE 1 OF 1
REV JHS 1-30-78

CONFIDENTIAL

Packing shall consist of a laminated graphite packing ring with one .004 thick sacrificial washer packaged with each ring of packing.

CERTIFICATION, PACKING AND ASSEMBLY REQUIRED PER FMS 17D16

Laminated Graphite Specifications

Graphite Content ---------- 99%
Density ---------- 70 LB/FT^3
Certified leachable chloride content 200 PPM maximum.
Lamination perpendicular to shaft.

Sacrificial Washer Specification

Material - Zinc ASTM B69 or Equivalent
Thickness - .004"
NOMINAL
NOMINAL I.D. = PACKING RING I.D. + 1/8 IN.
NOMINAL O.D. = PACKING RING O.D. - 1/16 IN.
WASHER MAY BE SPLIT TO EASE INSTALLATION

Approved Material:

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil Grade GTN

MAJOR REVISION - 6-5-78
BY ___ CHKD JHS APVD RTW DATE
840, OLD STOCK
1 X USE
2 __ REMACHINE
3 __ SCRAP/REWK
4 __ SCRAP MDN
EXPLAIN: 1 __ SAFETY 2 __ MAIL 3 X IMPROVE 4 __ ERROR
ECO, REASON
5 __ STOCK
6 __ COST
NEED CLOSER CONTROL OF ZINC RINGS

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GRAPHITE LAMINATE PACKING WITH SACRIFICIAL ZINC WASHER - LOW CHLORIDE

NO.	FMS 17D17 (A)
BY WDH	6-15-76
APVD RDW	9-16-76
PAGE 1	OF 1
REV	

CONFIDENTIAL (B)

Packing shall consist of a laminated graphite packing ring with one .004 thick sacrificial washer packaged with each ring of packing.

CERTIFICATION, PACKING AND ASSEMBLY REQUIRED PER FMS 17D16

Laminated Graphite Specifications

Graphite Content ---------- 99%
Density ---------- 70 LB/FT³
Certified leachable chloride content 200 PPM maximum at 1000 °F.
Lamination perpendicular to shaft.

Sacrificial Washer Specification

Material - Zinc ASTM B69 or Equivalent
Thickness - .004"

Approved Material:

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil Grade GTN

MAJOR REVISION 10-2-77
BY [illegible] CHKD [illegible] APVD [illegible]
LAB CALCULATION
1 LINE
2 ATTACHMENT
3 SURFACE FINISH
4 SCRAP FROM
EXPLAIN
1 SURVEY
2 SCRAP
3 INTERFERENCE
4 ERROR
5 CUSTOMER
6 COST
Reason
Classification

CONFIDENTIAL

MAJOR REVISION * DATE 6-10-94
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION 4 TO V

SPECIFICATION FOR FLEXIBLE GRAPHITE PACKING RINGS WITH LOW IMPURITIES

FISHER

New Page

Rev: V
By: JDC 6-13-94
Apvd: NTH 6-13-94
Page 2 of 2

*Fisher Controls — Revised By:

4. CERTIFICATION BY VENDOR

The packing must be manufactured, processed and handled in a manner that will allow certification. When certification is specified on the purchase order, the lot of packing material must be tested for the elements listed in 3 (c) above. A copy of the chemical analysis must accompany each individual order and/or package when certification is specified.

5. PACKAGING BY VENDOR

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and marked on the outside of the package to indicate that they have been specially processed. The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

6. HANDLING AND ASSEMBLY

Specially processed parts made to conform to this specification shall be handled in a manner that will maintain impurity content within specified the limit whether or not certification is required by customer specification.

7. APPROVED MATERIALS

(a) UCAR Carbon Co., Inc.
P.O. Box 94637
Cleveland, OH 44101
(216) 529-5777
Grafoil Grades GTA or GTJ

(b) EGC Enterprises, Inc.
7225 Industrial Parkway
Mentor, OH 44060
(216) 946-2210
UCAR Grafoil Grades GTA or GTJ

(c) NSP, Inc.
1601 Main St.
Sharpsburg, PA 15215
(412) 784-8416
Style 46300 Rings from UCAR Grafoil Grades GTA or GTJ

CONFIDENTIAL

Fisher Controls | Material Specification | FMS 17F48

METAL FOIL INSERT GRAPHITE GASKET MATERIAL

Rev: (F) G
By: WHH 11-8-85
Apvd: NFR 11-8-85
Page 1 of 1

FISHER

*Fisher Controls 1985, (1990) 1991 | Revised By: WHH (11-28-90) 12-19-91

1. SCOPE

This document describes a metal foil reinforced sheet graphite material, typically used for gasketing.

2. MATERIAL REFERENCE NO.

994E - Standard
994Y - Certified less than 100 ppm leachable chloride per FMS 17F43.

3. SPECIFICATIONS

(a) Composition: Graphite, ≥ 95% with S31600 foil insert, 0.002 inches thick.

(b) Thickness: 0.031 ± .005 inches.

(c) Density: 70 lbs/cu. ft. graphite only.

(d) Max. temperature limits: 800°F oxidizing media*
1300°F inert media

*Note: For oxygen service use FMS 17F49

4. ACCEPTED SOURCES

(a) (Union Carbide
Carbon Products Div.
Cleveland, OH
Style No. GHR) UCAR Carbon Co., Inc

(b) EGC Enterprises, Inc.
Nantor, OH

(c) Flexitallic Gaskets Co.
6440 Remington Ave.
Pennsauken, NJ 08110

JAN 2 0 1992

MAJOR REVISION

EOR/N NO. _____ DATE

BY WHH CHKD DRB APVD NFR

EXPLAIN: MIN. DIG STOCK; 1 ___ INCREASE; 2 ___ REWORK; 3 ___ SCRAP/REJ; 4 ___ SCRAP MSR; 5 ___ REJECTION; 1 ___ SAFETY; 2 ___ MAIL; 3 X IMPROVE; 4 ___ OTHER; 5 ___ STOCK; 6 ___ COST; 7 ___ MKTG/SALES

Update Vendor Name

Fisher Controls | Material Specification | FMS 17F46

METAL FOIL INSERT GRAPHITE GASKET MATERIAL

Rev: D
By: WHH 11-8-85
Apvd: NFR 11-8-85
Page 1 of 1

FISHER

*Fisher Controls 1985, 1990

Revised By: WHH 8-29-90

CONFIDENTIAL

1. SCOPE

This document describes a metal foil reinforced sheet graphite material, typically used for gasketing.

2. MATERIAL REFERENCE NO.

994E - Standard
994Y - Certified less than 100 ppm leachable chloride per FMS 17F43.

3. SPECIFICATIONS

(a) Composition: Graphite, ≥95% with 531600 foil insert, 0.002 inches thick.

(b) Thickness: 0.031 ± .005 inches.

(c) Density: 70 lbs/cu. ft. graphite only.

(d) Max. temperature limits: 800°F oxidizing media*
1500°F inert media

*Note: For oxygen service use FMS 17F49

4. ACCEPTED SOURCES

(a) Union Carbide
Carbon Products Div.
Cleveland, OH
Style No. GHR

(b) EGC Enterprises, Inc.
Mentor, OH

(c) Flexitallic Gaskets Co.
Bellmawr, NJ
Flexicarb SR

OCT 04 1990

MAJOR REVISION

ECR/N NO. _____ DATE

BY WHH CHKD BLT APVD NFR

Correct type

Fisher Controls | Material Specification | FMS 17F40

METAL FOIL INSERT GRAPHITE GASKET MATERIAL

Rev: (B) C
By: MHH 11-8-85
APVD: NFR 11-8-85
Page 1 of 1

FISHER

*Fisher Controls 1985, (1987) 1990 | Revised By: WHH 10-29-87

CONFIDENTIAL

1. SCOPE

This document describes a metal foil reinforced sheet graphite material, typically used for gasketing.

2. MATERIAL REFERENCE NOS. 994E

3. SPECIFICATIONS

(a) Composition: Graphite, ± 95% with 351600 foil insert, 0.002 inches thick.

(b) Thickness: 0.031 ± .005 inches.

(c) Density: 70 lbs/cu. ft. graphite only.

(d) Max. temperature limits: 800°F oxidizing media*
1500°F inert media

*Note: For oxygen service use FMS 17F49

4. ACCEPTED SOURCES

(a) Union Carbide
Carbon Products Div.
Cleveland, OH
Style No. GEM

(b) EGC Enterprises, Inc.
Mentor, OH

994E - standard
994Y - certified less than 100 ppm leachable chloride per FMS 17F43

MAJOR REVISION JAN 16 1990
ECR/R NO. ____ DATE
BY MHH CHKD DLB APVD NFR
REQ. FOR STOCK
1 X CUST
2 — RUSHES
3 — SCRAP/REW
4 — SCRAP NOW
REASON
ADD. VERSION
1 — SAFETY
2 — MAIL
3 X IMPROVE
4 — ERROR
5 — STOCK
6 — COST
7 — MKTG/SALES

Add MRN for certified low chloride gasket.

Fisher Controls | Material Specification | FMS 17F43

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 100 PPM OR LESS)

Rev: R
By: OJK 3-7-83
Apvd: EEA 3-7-83
Page 1 of 2

©Fisher Controls 1983, 1991 Revised By: WHH 4-30-91

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

REFERENCES

a) ASTM D512 - Test Methods for Chloride Ion in Water

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

APR 8 1998

5. ASSEMBLY

MAJOR REVISION
BORN No. 961397 Date 4/8/98
By. DM Chkd PDD Apvd TDG
540, Old Stock: 1_USE 2_REWORK 3_SCRAP/NEW 4_SCRAP NOW
Explain
590, Revision: 1_SAFETY 2_MATL 3_IMPROVE 4_ERROR 5_STD/SPEC 6_COST 7_MKTG/SALES

Specially processed parts made all not be handled by bare hands or uncle be used.

6. APPROVED MATERIALS

The following gasket materials or less leachable chlorides:

(a) Spiral Wound Gaskets

N06600/GTB Graphit
S31603/Composition
S30400/Composition
S30403/Composition
S31603/Corr. Inhib

Updated to the new electr
Any changes to appearance,
numbering, etc., were to acco
the new document format styl
appearance of the document w
the same as before. NO CHANG
CONTENT.

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2 or FMS 17N5

Fisher Controls | Material Specification | FMS 17F43

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 100 PPM OR LESS)

Rev: (P) Q
By: DJK 3-7-83
Apvd: ESA 3-7-83
Page 1 of 2

FISHER

*Fisher Controls 1983, (1990) 1991 Revised By: WHH 8-29-90

CONFIDENTIAL WHH 4-30-91

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

MAY 02 1991

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets

N06600/GTB Graphite, Low Chloride (9957)
S31603/Composition, FMS 17N2 (992U)
S30400/Composition, FMS 17N2 (992V)
S30403/Composition, FMS 17N2 (992W)
S31603/Corr. Inhibited graphite, FMS 17N2 (AA6C)

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2 or FMS 17N5

DATE
APVD ALTR
CHKD
ENGR
QUAL
MFG
SAFETY
MAINT
ENGINEER
MFG/ASSY
QUALITY
SCRAP/REW
Ltd material to list

Fisher Controls | Material Specification | FMS 17F43

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 100 PPM OR LESS)

Rev: (N) P
By: OJK 3-7-83
Apvd: EKA 3-7-83

*Fisher Controls 1983, 1990

Revised By: WHN 4-6-90

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets

N06600/GTB Graphite, Low Chloride (995T)
S31603/Composition, FMS 17N2 (992U)
S30400/Composition, FMS 17N2 (992V)
S30403/Composition, FMS 17N2 (992W)

SEP 07 1990

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

MAJOR REVISION
ECR/N NO. B8805 DATE
BY WHN CHKD RJG APVD.
BAD CHG SHEET SIGN REASON

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 100 PPM OR LESS)

Rev: (A) N
By: GJK 3-7-83
Apvd: EMA 3-7-83
Page 1 of 2

©Fisher Controls 1983, (1989) 1990 Revised By: WHH 6-1-89

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chlorides per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

Each order must be certified that the requirements have been met. — delete

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets

N06600/GFN Graphite, Low Chloride (9957)
S31603/Composition, FMS 17N2 (992U)
S30400/Composition, FMS 17N2 (992V)
S30403/Composition, FMS 17N2 (992N)
S31600/Composition, FMS 17N2 (992X) — delete

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

MAR 18 1990

DATE APVD AFK
CHKD DEA
ENGR WHH
DRWG NO.

Delete S31600 - not employed
Add S31603 Spiral Wound Graphite gasket

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 100 PPM OR LESS)

Rev: (L) M
By: DJK 3-7-83
Apvd: EEA 3-7-83

*Fisher Controls 1983, (1989) 1989 Revised By: WHH 2-22-88

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets

N06600/GTB Graphite, Low Chloride (9957)
S31603/Composition, FMS 17N2 (992U)
S30400/Composition, FMS 17N2 (992V)
S30403/Composition, FMS 17N2 (992W)
S31600/Composition, FMS 17N2 (992X)

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

JUN 06 1989

TAYLOR V. 3.M. COMPANY ET AL.
ROA_03729

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 100 PPM OR LESS)

CONFIDENTIAL

Rev: (E)
By: OJK 3-7-83
Apvd: EEA 3-7-83
Page 1 of 2

FISHER

©Fisher Controls 1983, (1987) 1988 Revised By: WHH 11-25-

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification. Each order must be certified that the requirements have been met.

Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

MAR 02 1988

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets

N06600/GTB Graphite, Low Chloride (9957)
S31603/Composition, FMS 17N2 (992U)
S30400/Composition, FMS 17N2 (992V)
S30403/Composition, FMS 17N2 (992W)
S31600/Composition, FMS 17N2 (992X)

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

Fisher Controls	Material Specification	No. FMS 17F43	J
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIALS (CERTIFIED 100 PPM OR LESS)	By OTK 3-7-83	
		Apvd BBA 3-7-83	
		Page 1 of 2	
©Fisher Controls 1983, 1987		Rev WHH 3-23-87	

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NOS. - Listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed and packaged in the manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

delete

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

To prevent contaminating, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride"

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
- N06600/GTG Graphite, Low Chloride (9957)
- S31603/Composition, FMS 17N2 (992U)
- S30400/Composition, FMS 17N2 (992V)
- S30403/Composition, FMS 17N2 (992W)
- S31600/Composition, FMS 17N2 (992X)

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2.

MAJOR REVISION DEC 09 1987
SCR/N NO. 86150 DATE
BY WHH CHKD RTE APVD NFR

ROA_03731
TAYLOR V. 3.M. COMPANY ET AL.

Fisher Controls

Material Specification

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIALS
(CERTIFIED 100 PPM OR LESS)

No. FMS 17F4J (4)

By DJH 3-7-83

Appd. 3-7-83

Page 1 of 2

Fisher Controls 1983, 1987 1986

Rev NRP 4-17-86

1. SCOPE

CONFIDENTIAL

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the chloride content must be minimized to reduce the degree of stress corrosion of stainless steel in the system.

2. MATERIAL REFERENCE NOS. - Listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed and packaged in the manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
- Nickel (Inconel) 600 w/GTB/Graphite, Low Chloride (9957)
- 316L SST w/Composition, FMS 17N2 (992U)
- 304 SST w/Composition, FMS 17N2 (992V)
- 304L SST w/Composition, FMS 17N2 (992W)
- 316 SST w/Composition, FMS 17N2 (992X)

Sources: Flexitallic Gasket Company or as specified on FMS 17N2

MAJOR REVISION

ECR/N NO. ____ DATE APR 1 1987

BY WHK CHKD JLG APVD NFR

REASON FOR CHANGE: 1 X USER; 2 ENGINEERING; 3 SCRAP/REWORK; 4 SCRAP HOST; CUSTOMER: 1 SAFETY; 2 X ECONOMY; 3 DEPENDENCE; 4 ERROR; 5 STORAGE; 6 COST; 7 MATERIAL SALES

Change to UNS designations, Delete Metric

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03732

Fisher Controls

FISHER

Material Specification

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIALS
(CERTIFIED 100 PPM OR LESS)

No. FMS 17F43 G

By OSK 8-1-83

Appd EBA 8-1-83

Page 1 of 2

©Fisher Controls 1983 (1985) 1986

Rev NRP 7-16-85

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the chloride content must be minimized to reduce the degree of stress corrosion at stainless steel in the system.

2. MATERIAL REFERENCE NOS. - Listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed and packaged in the manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
- Inconel 600 & GTS Graphite, Low Chloride (9957)
- 316L SST & Asbestos, Low Chloride (991R)
- 304 SST & Asbestos, Low Chloride (991T)
- 304L SST & Asbestos, Low Chloride (991U)
- 316 SST & Asbestos, Low Chloride (991Y)

delete

- 316L SST & Composition, FMS 17N2 (992U)
- 304 SST & Composition, FMS 17N2 (992V)
- 304L SST & Composition, FMS 17N2 (992W)
- 316 SST & Composition, FMS 17N2 (992X)

Sources: Flexitallic Gasket Company or as specified on FMS 17N2

JUL 1 1988

MAJOR REVISION

REMOVE ASBESTOS GASKET SOURCES

ECR/N NO. _____ DATE

BY NRP CHKD [illegible] APPR MAS

840, OLD STOCK

Fisher Controls | Material Specification | No. FMS 17F43 (F)

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIALS
(CERTIFIED 100 PPM OR LESS)

By DSK 3-7-83
Appd EBA 3-7-83
Page 1 of 2

©Fisher Controls 1983, 1984

Rev NRP 9-4-84

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the chloride content must be minimized to reduce the degree of stress corrosion at stainless steel in the system.

2. MATERIAL REFERENCE NOS. - Listed in parenthesis under Materials, Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed and packaged in the manner which will justify certification. Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. MATERIALS Approved Materials

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
- Inconel 600 & GTB Graphite, Low Chloride (9957)
- 316L SST & Asbestos, Low Chloride (991R)
- 304 SST & Asbestos, Low Chloride (991T)
- 304L SST & Asbestos, Low Chloride (991U)
- 316 SST & Asbestos, Low Chloride (991Y)

Sources: Flexitallic Gasket Company or as specified on FMS 17N2

- 316L SST & Composition, FMS 17N2 (991U)
- 304 SST & Composition, FMS 17N2 (991V)
- 304L SST & Composition, FMS 17N2 (991W)
- 316 SST & Composition, FMS 17N2 (991X)

JUL 25 1985

ECR/PI NO. ___ DATE ___
BY NRP ___ CHKD ___ APVD ___ DATE ___
PRELIM PROOF
ECO RELEASE
1 X ESK
2 — REVISED
3 — SCRAPPED
4 — SCRAP NOW
CORRECT PLASTRAK
5 — STOCK
6 — COST
7 — MATRL/SALES
APPROVED SOURCES, ADD NON-ASBESTOS
ELABORATE

CONFIDENTIAL

Fisher Controls	Material Specification	No. FNS 17F43 (E)
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIALS (CERTIFIED 100 PPM OR LESS)	By OSK 3-7-83
		Appvd EEA 3-7-83
		Page 1 of 2
©Fisher Controls 1983, 1984		Rev NRP 3-26-84

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 100 parts per million leachable chlorides. Presumably the chloride content must be minimized to reduce the degree of stress corrosion at stainless steel in the system.

2. MATERIAL REFERENCE NOS. - Listed in parenthesis under Materials.

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512-67. The items must also be manufactured, processed and packaged in the manner which will justify certification. Each order must be certified that the requirements have been met.

Delete

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. MATERIALS

The following gasket materials can be certified to contain 100 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
- Inconel 600 & GTS Graphite, Low Chloride (9957)
- 316L SST & Asbestos, Low Chloride (991R)
- 304 SST & Asbestos, Low Chloride (991T)
- 304L SST & Asbestos, Low Chloride (991U)
- 316 SST & Asbestos, Low Chloride (991Y)

Sources: Flexitallic Gasket Company

SEP 6 1984

DATE

BY NRP CHKD WHH APVD MCE

CUST. GIVE STOCK | REQ. REASON | DISPOSITION
1 X USE | 1 — SAFETY | 5 — STOCK
2 — RESEARCH | 2 X WEAR | 6 — DUST
3 — SCRAP/REPD | 3 — IMPROVE
4 — SCRAP NOW | 4 — ERROR

CONFIDENTIAL

Fisher Controls	Material Specification	No. FMS 17F43	C
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIALS (CERTIFIED 100 PPM OR LESS)	By OJK 3-7-83	
		Appd BEA 3-7-83	
		Page 2 of 2	
©Fisher Controls 1983, 1984		Rev NRP	2-3-84

(b) Flat Sheet graphite with 316 SST Screen. Can be certified less than 100 ppm leachable chlorides by the suppliers listed on FMS 17F30. If these gaskets are cut by an outside vendor, then that vendor must cut the gaskets per paragraph 4 and repackage per paragraph 5. (0452)

(c) Flat Sheet Asbestos Gaskets, Asbestos Composition, Low Chloride

Sources Manville - Style MX-4707 Sheet Packing, Low Chloride (0459)

omit

NOTE: Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room and the white room personnel shall cut, package and handle the cut gaskets to prevent contamination.

FEB 28 1984

(b) Flat Sheet graphite with 316 SST Screen. Can be certified less than 100 ppm leachable chlorides by the suppliers listed on FMS 17F38. If these gaskets are cut by an outside vendor, then that vendor must cut the gaskets per paragraph 4. and repackage per paragraph 5. (0492)

(c) Flat Sheet Asbestos Gaskets, Asbestos Composition, Low Chloride

Sources Manville - Style MX-4787 Sheet Packing, Low Chloride (0459)

NOTE: Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room and the white room personnel shall cut, package and handle the cut gaskets to prevent contamination.

FEB 7 1984

MAJOR REVISION
BY NEC CHKD [illegible] APVD [illegible]

SUBJECT
1 X DOC
2 __ MECHANICAL
3 __ SCRAP/REWK
4 __ SCRAP NEW

REASON
1 __ SAFETY
2 X MAIL
3 __ IMPROVE
4 __ ERROR

5 __ FROZN
6 __ COST
7 __ MATRL/SALES

ADD NEW MATERIAL TO SUPPLIER REQUEST FR. OTHER TO PROVIDE MATL FOR

CONFIDENTIAL

Fisher Controls	Material Specification	No. FMS 17F43 (A)
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIALS (CERTIFIED 100 PPM OR LESS)	By CDK 3-7-83
		Appd ERA 3-7-83
		Page 2 of 3
©Fisher Controls 1983		Rev MRP 7-22-83

(b) Flat Sheet graphite with 316 SST Screen. Can be certified less than 100 ppm leachable chlorides by the suppliers listed on FMS 17F38. If these gaskets are cut by an outside vendor, then that vendor must cut the gaskets per paragraph 4. and repackage per paragraph 5.

NOTE: Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room and the white room personnel shall cut, package and handle the cut gaskets to prevent contamination.

JUL 29 1983

MAJOR REVISION
BY MRP CHKD [illegible] APVD NER

UPDATE PAGE 1

Fisher Controls | Document Cover Sheet | FMS 17F30

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORINE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

Rev: S T
By: DJG 12-11-72
Apvd: BR 11-13-79
Page 1

CONFIDENTIAL

©Fisher Controls 1984, 1992

Revised By: MSH 4-30-92

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
1	S						
2	S						
3	S						
4	S						

FEB 10 1998

MAJOR REVISION
ECAN No. 96799 Date 4-4-97
By DM Chkd fmo Apvd TDG

640, Old Stock
1_ USE
2_ REWORK
3_ SCRAP/REW
4_ SCRAP NOW

800, Reason
1_ SAFETY
2_ MATL
3&5 IMPROVE
4_ ERROR
6_ STDZN
6_ COST
7_ MKTG/SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORINE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

CONFIDENTIAL

Rev: (B) 5
By: DJG 12-11-72
Apvd: BR 11-13-79
Page 1 of 2

©Fisher Controls 1984, 1990, 1992. Revised By: WHH (4-29-92) 4-30-92

1. SCOPE

1.1 This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

1.2 REFERENCES ADDED

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

6.1 Spiral Wound Gaskets JUN 3 1992

MAJOR REVISION

CR/H NO. _____ DATE 4-30-92
I WHH CHKD TDG APVD NSG
A OLD STOCK / B10. REASON / CUSTOMER
_ TIME / 1 _ SAFETY / 5 _ SERVICE
_ RECORDS / 2 _ MATL / 6 _ COST
_ SCRAP/REWK / 3 _ APPROVE / 7 _ MATRL
_ SCRAP NOW / 4 _ ERROR / SALES

Source(s): as specified on FMS 17N2 or FMS 17N5

Add low chloride grades of graphite sheet

- 6.1.1 304/corr. inhibited graphite, FMS 17N5 (994J)
- 6.1.2 316/composition, FMS 17N2 (992T)
- 6.1.3 321/composition, FMS 17N2 (993T)
- 6.1.4 347/composition, FMS 17N2 (993U)
- 6.1.5 660/corr. inhibited graphite, FMS 17N5 (994R)

*Fisher Controls 1984, 1988 Revised By: W/HH 3-2-88

CONFIDENTIAL

(b) Metal Jacketed Gaskets

531603/composition, FMS 17N1, low chloride (993R)
N04400/composition, FMS 17N1, low chloride (993S)
S30400/composition, FMS 17N1, low chloride (993V)
copper/composition, FMS 17N1, low chloride (994G)

Source(s): as specified on FMS 17N1

(c) Flat Sheet Gaskets

Composition sheet, low chloride, FMS 17A5 (0464)
Composition sheet, low chloride, FMS 17A5 (0467)

Source(s): as specified on FMS 17A5

NOTES:

1. Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room. The white room personnel shall cut, package and handle cut gaskets to prevent contamination.

2. In addition to the above listed materials, any material listed in FMS 17F43 (100 ppm chloride or less) may be used for this specification.

(d) Spring Loaded Seal Rings

N10276/PTFE with glass fiber and molybdenum disulfide fillers, low chloride (994N)

MAJOR REVISION APR 26 1988

ECO/N NO. _____ DATE

BY Whitt APVD RLT APVD MFK

Add 3 new gasket matls to spec.

©Fisher Controls 1984, (1988) 1990 Revised By: WHH 4-.3-88

CONFIDENTIAL

(b) Metal Jacketed Gaskets

S31603/composition, FMS 17N1, low chloride (993R)
N04400/composition, FMS 17N1, low chloride (993S)
S30400/composition, FMS 17N1, low chloride (993V)
Copper/composition, FMS 17N1, low chloride (994C)

Source(s): as specified on FMS 17N1

(c) Flat Sheet Gaskets

Composition sheet, low chloride, FMS 17A5 (0460)
Composition sheet, low chloride, FMS 17A6 (0467)

Source(s): as specified on FMS 17A5 or FMS 17A6

(d) Spring Loaded Seal Rings

N10276/PTFE with glass fiber and molybdenum disulfide fillers, low chloride (994N)

NOTES:

1. Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room. The white room personnel shall cut, package and handle cut gaskets to prevent contamination.

2. In addition to the above listed materials, any material listed in FMS 17F43 (100 ppm chloride or less) may be used for this specification.

SEP 07 1990

MAJOR REVISION

ECR/N NO. _____ DATE

BY WHH CHKD DJG APVD NFR

BAD. REASON
1 — SAFETY
2 — WASTE
3 — NONPROVE
4 — ERROR
5 — STDZN
6 — COST
7 — WRNG/ UNCLR

EXPLAIN

Add reference to FMS 17A6

Fisher Controls | Material Specification | FMS 17F30

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

CONFIDENTIAL

Rev: (ND P
By: DJG 12-11-72
Apvd: BR 11-13-79
Page 1 of 2

©Fisher Controls 1984, 1987 1988

Revised By: WHH 11-25-87

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

NRN's are listed in parenthesis under Approved Materials (Section 6 below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate "low chloride."

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

MAR 30 1988

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM OR LESS leachable chlorides:

EGR/H NO. _____ DATE

BY WHH CHKD DCB APVD NFK

(a) Spiral Wound Gaskets
corr. inhibited 5
S31603/graphite, FMS 17N3 (994J)
S31603/composition, FMS 17N2 (992T)
S32100/composition, FMS 17N2 (993T)
S30400/composition, FMS 17N2 (993U)
Nickel/corr. inhibited graphite, FMS 17N5 (994R)

Source(s): as specified on FMS 17N2 or FMS 17N3 5

Added another SWG to list, corrected one gasket description

Fisher Controls	Material Specification	No. FMS 17F30 M
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIAL (CERTIFIED 200 PPM OR LESS)	By DJG 12-11-72
		Appd BE 11-13-72
		Page 1 of 2
©Fisher Controls 1984, 1987		Rev WHH 5-20-87

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRR's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

delete

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

To prevent contamination, items shall be individually packaged in sealed plastic bags or envelopes. Labels or markings outside the package will indicate low chloride.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets S31603/graphite, FMS 17N3 (994J)
S31603/composition, FMS 17N2 (992T)
S32100/composition, FMS 17N2 (993T)
S30400/composition, FMS 17N2 (993U)

REC 09 1987

Source(s): as specified on FMS 17N2 or FMS 17N3

MAJOR REVISION
ECR/N No. A615 DATE
BY WHH CHKD RJF APVD NFR
840. OLD STOCK 1 X USE 2 __ REMOVE 3 __ SCRAPPED
830. REASON 1 __ SAFETY 2 __ WEAR 3 __ IMPROVE 5 __ STOCK 7 __ OTHER

Fisher Controls	Material Specification	No. FMS 17F30
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIAL (CERTIFIED 200 PPM OR LESS)	By DJG 12-11-72
		Apvd BR 11-13-74
		Page of 2
©Fisher Controls 1984, 1986		Rev NRP 6-17-86

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
316L graphite, FMS 17N3 (9941)
316L and composition, FMS 17N2 (992T)
321 and composition, FMS 17N2 (993T)
304 and composition, FMS 17N2 (993U)

Source(s): Flexitallic Gasket Company ~~or as specified on FMS 17N2~~

MAJOR REVISION
AUG 08 1986
ECR/F NO. _____ DATE
BY NRP ADD WITH APVD NFR
ADD 316L/GRAPHITE

Fisher Controls	Material Specification	No. FMS 17E30 L (R)
FISHER	SPECIAL HANDLING SPECIFICATION FOR LOW-CHLORIDE GASKET MATERIAL (CERTIFIED 200 PPM OR LESS)	By DJG 12-11-72
		Apvd BR 11-13-79
		Page 2 of 2
©Fisher Controls 1984, 1986		Rev NRP 6-17-86

CONFIDENTIAL

(b) Metal Jacketed Gaskets

316L and composition, FMS 17N1, low chloride (993R)
Monel and composition, FMS 17N1, low chloride (993S)
304 and composition, FMS 17N1, low chloride (993V)

Source(s): as specified on FMS 17N1

(c) Flat Sheet Gaskets

Composition sheet, low chloride, FMS 17A5 (0464)

Source: as specified on FMS 17A5

NOTES:

1. Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room. The white room personnel shall cut, package and handle cut gaskets to prevent contamination.

2. In addition to the above listed materials, any material listed in FMS 17F43 (100 ppm chloride or less) may be used for this specification.

AUG 08 1986

MAJOR REVISION

ECO/S NO. _____ DATE:

BY NRP CHKD WHH APPD NEE

ADD SHEET GRAPHITE SPIRAL GASKETS

Fisher Controls | Material Specification | No. FMS 17F30 (5)

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

By DSG 12-11-72
Appd AR 11-13-79
Page 1 of 2

©Fisher Controls 1984 1985 1986

Rev NRP 7-15-86

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
- 316L and asbestos, low chloride (9956)
- 321 and asbestos, low chloride (9971)
- 304 and asbestos, low chloride (9983)

delete

- 316L and composition, FMS 17N2 (992T)
- 321 and composition, FMS 17N2 (993T)
- 304 and composition, FMS 17N2 (993U)

JUL 1 1986

Source(s): Flexitallic Gasket Company or as specified on FMS 17N2

MAJOR REVISION

DELETE ASBESTOS GASKET MATLS

ECN/# NO. _____ DATE
BY NRP CHKD WHH APVD NAR

Fisher Controls | Material Specification | No. FRS 17F30

FISHER

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIAL
(CERTIFIED 200 PPM OR LESS)

By DSG 12-11-79
Apvd BR 11-13-79
Page 1 of

©Fisher Controls 1984 | Rev MRP. 2-21-84

CONFIDENTIAL

1. SCOPE

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. MATERIAL REFERENCE NUMBERS

MRN's are listed in parenthesis under Approved Materials (Section 6, below).

3. CERTIFICATION

Items purchased to this specification must be tested for leachable chloride per ASTM D512. The items must also be manufactured, processed, and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. PACKAGING

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly area.

5. ASSEMBLY

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. MATERIALS APPROVED MATERIALS

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

(a) Spiral Wound Gaskets
316L and asbestos, low chloride (9956)
321 and asbestos, low chloride (9971)
304 and asbestos, low chloride (9983)

Sources: Flexitallic Gasket Company or as specified on FMS 1142:

316L per composition, FMS 1142 (9956)
321 " " , FMS 1142 (9971)
304 " " , FMS 1142 (9930)

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03748

FISHER Controls

MARSHALLTOWN, IOWA

11-19-79

MATERIAL SPECIFICATION

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIALS

NO. MHS 17730
BY [illegible] [illegible]
APVD [illegible] 11-13-79
PAGE 1 OF [illegible]
REV PEMA 11-13-79

MRP 28 2A-83

CONFIDENTIAL

1. Scope

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides. Presumably the leachable chloride content must be minimized to reduce the degree of stress corrosion of stainless steel materials.

2. ~~Purpose of Requirement~~ Material Reference Nos.

~~MRN's are listed in parenthesis under Approved Materials (Section 6, below).~~

~~Presumably the chloride content must be as low as practicable in components because of the danger of stress corrosion in stainless steel in the system.~~

3. Certification

Items purchased to this specification must be tested for leachable chloride per ASTM D512-67. The items must also be manufactured, processed and packaged in a manner which will justify certification.

Each order must be certified that the requirements have been met.

4. Packaging:

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. Assembly

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. Materials

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides:

a) Spiral-Wound Gaskets 316L and Asbestos, Low Chloride (9954)
~~Inconel 600 & PTFE Graphite, Low Chloride~~
Sources: Flexitallic Gasket Company 304 and Asbestos, Low Chloride (9970) 304 and Asbestos, Low Chloride (9983)
~~Metal Clad Gaskets Monel and Asbestos, Low Chloride~~
~~316L and Asbestos, Low Chloride~~
~~Sources: Johns-Manville Style 922~~

b) Flat Sheet Asbestos Gaskets Asbestos Composition, Low Chloride (9435)
Sources: Johns-Manville Style HX-4787 Sheet Packing - Low Chloride

Notes: Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original unopened roll in the white room and the white room personnel shall cut, package and handle the

MAJOR REVISION BY NEP CHKD MHS APVD [illegible] DATE 2-28-84

MONTHLY REVIEW WITH PURCHASING GROUP TO DISCUSS PROBLEMS

Fisher Controls
IRSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SPECIAL HANDLING SPECIFICATION
FOR LOW-CHLORIDE GASKET MATERIALS

NO. FHS 17F1D F
BY D.M.G. 12/11/72
APVD
PAGE 1 OF 1
REV B/5 9-22-77

CONFIDENTIAL

TESTED FOR LEACHABLE CHLORIDE PER ASTM D512-67. THE ITEMS MUST ALSO BE MANUFACTURED PROCESSED AND PACKAGED IN A MANNER WHICH WILL JUSTIFY CERTIFICATION.

1. Scope

This specification establishes a procedure for purchasing, handling, and assembling gasket materials, which must not contain more than 200 parts per million leachable chlorides (at 1000°F) — omit

2. Purpose of Requirement

Presumably the chloride content must be as low as practicable in components because of the danger of stress corrosion in stainless steel in the system.

3. Certification

~~Items purchased to this specification must be manufactured, processed~~ and packaged in a ~~manner which will justify~~ certification by the supplier.

Each order must be certified that the requirements have been met.

Packaging

Items must be packaged in sealed plastic bags or envelopes which will prevent contamination and which are marked to indicate that they have been specially processed.

The sealed containers shall not be opened until ready for assembly in the appropriate assembly areas.

5. Assembly

Specially processed parts made to conform to this specification shall not be handled by bare hands or unclean instruments. Clean gloves should be used.

6. Materials

The following gasket materials can be certified to contain 200 PPM or less leachable chlorides (at 1000°F) — omit

a. Spiral-Wound Gaskets — 316L and Asbestos, Low Chloride; Inconel 600 & GTB Graphite, Low Chloride
   Sources: Flexitallic Gasket Company

b. Metal Clad Gaskets — Monel and Asbestos, Low Chloride; 316L and Asbestos, Low Chloride
   Sources: Johns-Manville Style 923

c. Flat Sheet Asbestos Gaskets — Asbestos Composition, Low Chloride
   Sources: Johns-Manville Style HX-4787 Sheet Packing - Low Chloride

NOTE: Sheet gasket material must be handled similarly to that used for oxygen service. Fisher shall keep material in the original wrapped roll in the white room and the white room personnel shall cut, package and handle the cut gaskets to prevent contamination.

MAJOR REVISION — BY [illegible] DATE [illegible] APVD [illegible] DATE [illegible]
ADD ASTM D512-67

Fisher Controls | Material Specification | FMS 17F29

PTFE COATED METAL GASKET MATERIAL

Rev: K
By: REA 1-5-72
Apvd: TKB 10-16-81
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1988, 1991

Revised By: WHH 12-19-91

1. SCOPE

This standard covers polytetrafluoroethylene (PTFE) coated metal sheet materials used in special gasket applications.

2. MATERIAL REFERENCE NOS.

9912	N04400/PTFE
9919	R60702 (Zirconium alloy)/PTFE
9922	N08020/PTFE, oxygen service, per FGS 8A11
9928	C11000/PTFE
992L	N10665/PTFE
992M	S31603/PTFE
992N	N10276/PTFE
992P	N08020/PTFE
994H	S31603/PTFE, oxygen service, per FGS 8A11
994L	S30403/PTFE
994U	R56400/PTFE
994V	N02200/PTFE
9991	N04400/PTFE, oxygen service, per FGS 8A11

3. MATERIAL DESCRIPTION

Cold rolled annealed metal sheet, as specified in Sec. 2, coated with PTFE .005" to .006" per surface. Adhesion should be equal to or greater than the strength of the PTFE coating.

4. MAXIMUM USE TEMPERATURE

450°F

5. APPROVED SOURCES

(a) K & L Precision Plastics
Richardson, TX

(b) E/M Lubricants
West Lafayette, IN

FEB 10 1998

MAJOR REVISION
ECRN No. 961398 Date ▸ 4-18-97
By DM Chkd PMH Apvd TPG
040, Old Stock
1_Use
2_REWORK
3_SCRAP/NEW
4_SCRAP NOW
030, Reason
1_SAFETY 6_STDZN
2_MATL 5_COST
3_IMPROVE 7_MKTG/SALES
4_ERROR
ECRN

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | FMS 17F29

PTFE COATED METAL GASKET MATERIAL

FISHER

CONFIDENTIAL

Rev: (D) H
By: REA 1-6-72
Aprvd: TKH 10-16-81
Page 1 of 1

*Fisher Controls 1980, 1989 Revised By: WHH 8-16-88

1. SCOPE

This standard covers polytetrafluoroethylene (PTFE) coated metal sheet materials used in special gasket applications.

2. MATERIAL REFERENCE NOS.

992L	N10665/PTFE	
992M	S31603/PTFE	
9912	N04400/PTFE	
992N	N10276/PTFE	
992P	N08020/PTFE	
9991	N04400/PTFE, oxygen service, per FGS 8A11	
994H	S31603/PTFE, oxygen service, per FGS 8A11	
994L	S30403/PTFE	
9922	N08020/PTFE, oxygen service, per FGS 8A11	
9919	R60702 (Zirconium alloy)/PTFE	

add

9928	C11000/PTFE
994U	R56400/PTFE
994V	N02200/PTFE

(put in numerical order)

3. MATERIAL DESCRIPTION

Cold rolled annealed metal sheet, as specified in Sec. 2, coated with PTFE .005" to .006" per surface. Adhesion should be equal to or greater than the strength of the PTFE coating.

4. APPROVED SOURCES

(a) K & L Precision Plastics
Richardson, TX

(b) E/M Lubricants
West Lafayette, IN

NOV - 7 1989

MAJOR REVISION

ECR/N NO. _____ DATE>
BY WHH CHKD DRD APVD NFR

Add new materials

Fisher Controls	Material Specification	No. FMS 17F29	E
FISHER	PTFE COATED METAL GASKET MATERIAL	By REA 1-6-72	
		Appvd NRP 10-16-81	
		Page 1 of 1	
©Fisher Controls 1981, 1986		Rev NRP 6-17-86	

CONFIDENTIAL

1. SCOPE

This standard covers polytetrafluoroethylene (PTFE) coated metal sheet materials used in special gasket applications.

2. MATERIAL REFERENCE NOS.

992L Hastelloy B-2/PTFE N10665 /PTFE
992M 316L SST/PTFE S31603/PTFE
9912 Monel-Alloy 400 ASTM B127/PTFE N04400/PTFE
992N Hastelloy C-276/PTFE N10276 /PTFE
992P Alloy 20/PTFE N08020/PTFE
9991 Monel/PTFE oxygen service, per FGS 8A11 N04400/PTFE
994H 316L SST/PTFE oxygen service, per FGS 8A11 S31603/PTFE
994L S30403 /PTFE

3. MATERIAL DESCRIPTION

Cold rolled annealed metal sheet, as specified in Sec. 2, coated with PTFE .005" to .006" per surface. Adhesion should be equal to or greater than the strength of the PTFE coating.

4. APPROVED SOURCES

(a) K & L Precision Plastics
Richardson, TX

(b) E/M Lubricants
West Lafayette, IN

MAJOR REVISION
ECR/R NO. _____ DATE
BY WHH CHKD JRB APVD NFR
340 OLD STOCK
1 ☒ USE
2 — REPAINT
3 — SCRAP/REWORK
4 — SCRAP NOW
5 — STOCK
6 — COST
7 — QA/TH/SALES

Add new listing
Convert existing material listings to new standard form.

FISHER Contract
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

PTFE COATED MONEL GASKET MATERIAL
METAL

NO. MMS 17F29 C
BY REA 1-6-72
APVD TKB 10-11-71
PAGE 1 OF 1
REV. 9 SM 10-15-81

CONFIDENTIAL

1. SCOPE polytetrafluoroethylene (PTFE)

This standard covers fluoroplastic coated Monel Alloy 400 metal sheet materials used in special gasket applications.

2. MATERIAL REFERENCE NOS. 9912 delete

9921 Hastelloy B-2 / PTFE
992M Steel SST / PTFE
9912 Monel Alloy 400, ASTM B127 / PTFE
993H Hastelloy C-276 / PTFE
992P Alloy 20 / PTFE
9991 Monel / PTFE, oxygen service, per IGS 841

3. MATERIAL DESCRIPTION

Delete Monel Alloy 400 ASTM B127 Cold rolled annealed metal sheet, as specified in Sec. 2, coated with Virgin delete PTFE .005" to .008" per surface. Adhesion should be equal to or greater than the strength of the PTFE coating.

4. APPROVED SOURCES

(a) Penn Dixon Corp. Cliffcon Heights, PA delete
(b) Johns-Manville Denver, CO delete

(a) K & L Precision Plastics Richardson, TX
(b) E/M Lubricants West Lafayette, IN

APR 9 1985

MAJOR REVISION BY NRP CHKD WWH APVD NPR DATE
REQ. OLD STOCK 1 USE 2 REMACHINE 3 SCRAP/REWK 4 SCRAP NOW
REASON 1 SAFETY 2 MFTL 3 IMPROVE 4 ERROR 5 STDZN 6 COST 7 MKTG/SALES

ALTER SPEC. & ADD 2 MATLS AFTER DELETING 2 MATLS & ADD OTHER METALS & THEIR REQ. CODES

© FISHER CONTROLS, 1981, 1985

FLEXIBLE GRAPHITE SHEET
(GASKET MATERIAL)

Rev: F G
By: LRM 6-22-71
Apvd: NFR 9-27-88
Page 1 of 1

FISHER

*Fisher Controls 1988, 1993

Revised By: TDG 3-24-93

CONFIDENTIAL

1. SCOPE

1.1 This document describes the graphite material to be used in gasket applications.

1.2 This standard includes references to the following documents:

(a) FGS 8A11, Cleaning and Handling for Oxygen and Other Special Services
(b) FMS 17F30, Special Handling Specification for Low-Chloride Gasket Material
(Certified 200 ppm or less)
(c) FMS 17F43, Special Handling Specification for Low-Chloride Gasket Material
(Certified 100 ppm or less)

2. MATERIAL REFERENCE NOS.

(a) 0431 Standard Grade
(b) 0438 ≤ 100 ppm chloride per FMS 17F43
(c) 043A ≤ 200 ppm chloride per FMS 17F30 & oxygen service per FGS 8A11

3. SPECIFICATIONS

(a) Thicknesses and Tolerances 0.005" to 0.030" ± .002"
(For Reference Only) 0.063" & 0.075" ± .005"

(b) Composition

(1) Graphite 95% Minimum
(2) Ash 5% Maximum

FEB 10 1998

MAJOR REVISION
EORM No. 961398 Date 2/4/97
By DM Chkd PbD Apvd TDG
Scrp, Old Stock
1_USE
2_REWORK
3_SCRAP/NEW
4_SCRAP NOW
Explain
800, Hanson
1_SAFETY 5_STOCK
2_MATL 6_COST
3_APPROVE 7_MKTG/SALES
4_ERROR

4. TYPICAL PROPERTIES

(a) Nominal Density 70 lb/cu. ft.
(b) Sublimation Point 6600°F

5. TEMPERATURE RANGE

(a) -400°F to 850°F in oxidizing atmosphere
(b) -400°F to 3000°F in inert atmosphere

6. ACCEPTED SOURCE

UCAR Carbon Co., Inc.

Trade Name - GTB or GHB Grafoil

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc, were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | FMS 17F28

FLEXIBLE GRAPHITE SHEET
(GASKET MATERIAL)

Rev: D E
By: LBM 6-22-71
Apvd: NFR 9-27-88
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1988, 1991 1492 Revised By: WHH 12-6-91

9-3042

1. SCOPE

1.1 This document describes the graphite material to be used in gasket applications.

1.2 → 2. MATERIAL REFERENCE NOS.

(a) 0431
(b) 0438 ≤ 100 ppm chloride per FMS 17F43
(c) 043A ≤ 200 ppm chloride per FMS 17F30 & oxygen service per FGS 8A11

3. SPECIFICATIONS

(a) Thicknesses and Tolerances 0.005" to 0.030" ± .002
0.075" ± .005

(b) Composition

(1) Graphite 95% Minimum
(2) Ash 5% Maximum

4. TYPICAL PROPERTIES

(a) Nominal Density 70 lb/cu. ft.
(b) Sublimination Point 6600°F

5. ACCEPTED SOURCE

6. UCAR Carbon Co., Inc.

Trade Name - GTB or GHB Grafoil

5. TEMPERATURE RANGE

(a) −400°F to 850°F in oxidizing atmosphere
(b) −400°F to 3000°F in inert atmosphere

MAJOR REVISION JUN 16 1992

ECR/IS NO. DATE 4-30-92
BY WHH CHKD TDS APVD DKE
ENG. CHG. STOCK
2 X USE
2 OBSOLETE
3 SCRAP/REWORK
4 SCRAP ONLY
ENG. REASON
1 SAFETY
2 MAKE
3 X IMPROVE
4 ERROR
5 STOCK
6 COST
7 DATE/SCHED

Added application temperature range for vit. . . .

Fisher Controls | Material Specification | FMS 17F20

FLEXIBLE GRAPHITE SHEET
(GASKET MATERIAL)

Rev: (B) C
By: LHH 6-22-71
Apvd: NFE 9-27-88
Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls 1988, 1991

Revised By: WHH (6-26-91)
8-23-91

1. SCOPE

This document describes the graphite material to be used in gasket applications.

2. MATERIAL REFERENCE NOS.

(a) 0431
(b) 0438 Low chlorides per FMS 17F43

3. SPECIFICATIONS

(a) Thicknesses and Tolerances 0.010" ± .002
0.020" ± .002
0.030" ± .002
0.075" ± .005

(b) Composition

(1) Graphite 95% Minimum
(2) Ash 5 Maximum

4. TYPICAL PROPERTIES

(a) Nominal Density 70 lb/cu. ft.
(b) Sublimation Point 6600°F

5. ACCEPTED SOURCE

Union Carbide Corporation
Carbon Products Div.

UCAR Carbon Co., Inc.

Trade Name - GTB Grafoil

AUG 29 1991

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD RTE APVD NFE
CHG. DESTOCK
1 USE
2 REWORK
3 SCRAP/RTRN
4 SCRAP ROW
EXPLAIN
CHG. REASON
1 SAFETY
2 MAIL
3 IMPROV
4 ERROR
5 STOCK
6 COST
7 MATL/SALES

change vendor

Fisher Controls

FISHER

Material Specification

GRAPHITE LAMINATE
(GASKET MATERIAL)

No.	FHS 17923	C
Dr JDP	8-4-68	
Apvd TKB	11-8-82	
Page 1 of 1		
Rev DRW	11-8-82	

©Fisher Controls 1992

CONFIDENTIAL WHH 4-30-93

1. SCOPE

This specification describes a laminated graphite material used primarily as a gasket.

2. MATERIAL REFERENCE NO. 0426

3. SPECIFICATIONS

(a) Composition: Flexible graphite sheet
Ash content: < 0.1%

(b) Density: 70 lb./cu. ft.

(c) Sublimation Point: 6600°F

(d) Recommended use temperature range:

-400°F to 850°F in oxidizing atmosphere
-400°F to 3000°F in inert atmosphere

4. APPROVED SOURCE

(a) Union Carbide Corp. UCAR Carbon Co.
Carbon Products Div.
Chicago, IL
Trade Name - GTA Grafoil (High Purity Grade)

JUN 16 1992

MAJOR REVISION
ECR/N NO. _____ DATE 4-30-92
BY WHH CHKD TGG APVD DRB

0 PRE. ORD STOCK	REASON		5 STOCK
1 USE	1 SAFETY		6 COST
2 SPECIFIC	2 QUAL.		7 MATRL/
3 SCRAP/REW.	3 IMPROVE		SALES
4 SCRAP/NEW	4 ERROR		

Company name change.

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17F23 (A)
	GRAPHITE LAMINATE (GASKET MATERIAL)	ISSUED JDP 8-7-68
		REV. JDP 8-12-68
		PAGE 1 OF 1

CONFIDENTIAL B

Thickness (In.)	.030 ± .002
Density	75 Lb/Cu Ft
Sublimination Point (°F)	6600
Thermal Expansion (10^{-6} In./In.°F)	
"C" Direction or Normal to Layers (70-4000° F)	15
"A" Direction or Parallel to Layers	
70-2000° F	-0.2
2000-4000° F	0.5
Compressive Strength (Lb/Sq in.)	
"C" Direction or Normal to Layers	
10% Reduction in Thickness	500
Ultimate	12,000

Approved Source:

Union Carbide Corporation
Carbon Products Division
Trade Name - Grafoil

GTA

MAJOR REVISION 5-1-70
BY DGS CHKD RWK APVD DATE

540, OLD STOCK 530, REASON
1 USE 1 SAFETY 5 SIZE
2 REMACHINE 2 MFR. 6 COST
3 SCRAP/NEW 3 IMPROVE
4 SCRAP FROM 4 ERROR

CHANGE IN TRADENAME

Fisher Controls | Material Specification | FMS 17F20

PLASTIC ALLOY SEAT RING MATERIAL

Rev: F-C
By: KEN 10-26-61
Apvd: TKB 11-8-82
Page 1 of 1

FISHER

*Fisher Controls 1982, (1990) 1991 | Revised By: WHH 8-24-90

10-15-91

CONFIDENTIAL

1. SCOPE

This specification describes a carbon/graphite filled fluoroplastic material primarily used in seat ring and valve stem packing applications.

2. MATERIAL REFERENCE NO. 0690

3. SPECIFICATIONS

(a) Composition: Virgin PTFE (polytetrafluoroethylene) with 25% carbon/graphite filler

(b) Form: Bar or sheet stock, or finished shapes

(c) Hardness: ASTM 2240 (Type D) 60-70

(d) Maximum continuous use temperature: 450°F

4. APPROVED SOURCES

(a) The Mather Co., Fluorotec Div.
Milan, MI.
Compound No. 1-X30-X-01

(b) Norton Performance Plastics
Elk Grove, IL
Compound No. TF-16 (25%)

(c) Chicago Gasket Co.
Chicago, IL
Compound: Ebolon No. 40

OCT 30 1991

DATE

APVD VFR

MAX Max continuous use temp.

Fisher Controls	Material Specification	No. FMS 17F20
FISHER	PLASTIC ALLOY SEAT RING MATERIAL	By KEL 10-26-88
		Appd TKB 11-3-92
		Page 1 of 1
©Fisher Controls 1987, (1993) 1988		Rev NOP 10-13-93

CONFIDENTIAL

1. SCOPE

This specification describes a carbon/graphite filled fluoroplastic material primarily used in seat ring applications and valve stem packing applications.

2. MATERIAL REFERENCE NO. 0690

3. SPECIFICATIONS

(a) Composition: Virgin PTFE resins (polytetrafluoroethylene) with 25% carbon/graphite filler

(b) Form: Bar or sheet stock, or finished shapes.

(c) Hardness: ASTM 2240 (Type D) 60-70

4. APPROVED SOURCES

(a) The Mather Co., Fluorotec Div.
Milan, MI.
Compound No. 1-X30-X-01

(b) Halogen Insulator and Seal Corp.
Elk Grove, IL
Compound No. TF-16 (25%)

(c) Chicago Gasket Co.
Chicago, IL.
Compounds: Ebolon No. 48

SEP 26 1988

MAJOR REVISION

ECR/N NO. _____ DATE

BY WJH CHKD RLT APVD NEP

Add application + change to standard nomenclature.

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17F20 C (B)
	PLASTIC ALLOY SEAT RING MATERIAL CONFIDENTIAL	ISSUED 10-26-67
		REV. 12-23-68
		PAGE 1 OF 1

1. SCOPE

This specification describes a carbon/graphite filled fluoroplastic material primarily used in seat ring applications.

2. MATERIAL REFERENCE NO. 0690

3. SPECIFICATIONS

(a) Composition: Virgin TFE resins (polytetrafluoroethylene) with 25% carbon/graphite filler.

Material - Carbon Filled Plastic - TFE

Hardness - Durometer D62-D66

(b) Form: Bar or sheet stock, or finished shapes.

(c) Hardness: ASTM 2240 (Type D) 60 - 70

4. APPROVED SOURCES

(a) The Mather Co., Fluorotec Div.
Milan, MI.
Compound No. 1-X30-X-01

Approved Compounds:

The Mather Co. Compound #17-01-1095 (4397-1)

Purchase From:

The Mather Company, Fluorotec Division
525 Redman
Milan, Michigan 48160

(b) Halpgen Insulation and Seal Corp.
Elk Grove, IL.
Compound No. TF-16 (25%)

NOV 17 1982

MAJOR REVISION DATE
BY CHKD APVD

REQ. OLD STOCK	REQ. REASON	
1 — USE	3 — SAFETY	5 — STOCK
2 — REMACHINE	4 — MAINT.	6 — COST
3 — SCRAP/NOW	2 — IMPROVE	7 — MATRL/ PARTS
4 — SCRAP NOW	1 — ERROR	

Revised to current specification

Fisher Controls | Material Specification | FMS 17F16

25% GLASS FILLED PTFE

Rev: (D) J
By: PJB 8-4-05
Apvds: TKB 11-8-82
Page 1 of 1

FISHER

*Fisher Controls 1982, (1986) 1991 | Revised By: WHH (7-12-89) 7-2-91

CONFIDENTIAL

1. SCOPE

This specification describes a glass filled PTFE material used primarily for gaskets, bushings, seat rings, and other special applications.

2. MATERIAL REFERENCE NOS.

(a) 0418

(b) 0409 for oxygen service and clean/handle per FCS 0411

3. SPECIFICATIONS

(a) Composition: Virgin PTFE (polytetrafluoroethylene) with 25% glass filler. Compound should contain no reprocessed PTFE filler. Also no appreciable amount of color or tint should be added. (White, beige or grey acceptable).

(b) Form: Bar stock, sheet or finished shape.

(c) Process: Compression molded or ram extruded.

4. APPROVED SOURCES

(a) Chicago Gasket Co.
Chicago, IL
Compound No. 23 Ebolon

(b) Crane Packing Co.
Morton Grove, IL
Compound No. 70006

(c) Halogen Insulator & Seal Corp.
Elk Grove, IL
Compound No. TF-8 (25%)

(d) ~~Fluorocarbon Co.~~ Furon Advanced Polymers Group
Mundelein, IL
Compound No. 409027

(e) Argo Packing Co.
Oakmont, PA
Style No. 704

(f) United Polymer Co.
Houston, TX
Style No. 1025

SEP. 22 1991

MAJOR REVISION

ECR/B NO. _____ DATE

BY WHH CHKD DRB APVD NFR

EXPLAIN: SHLD. OLD STOCK: 1 — USE, 2 — REWORK, 3 — SCRAP/REW., 4 — SCRAP MAT'L
SHLD. REASON: 1 — SAFETY, 2 — MAT'L, 3 — IMPROVE, 4 — ERROR, 5 — STDLR, 6 — COST, 7 — MKTG/SALES

Update Vendor Name

Fisher Controls	Material Specification	No. FMS 17F16 (E)
FISHER	25% GLASS FILLED PTFE (TFE RESIN)	By FJS A-4-65
		Appvd TKB 11-8-82
		Page 1 of 1
©Fisher Controls 1982, (1985) 1988		Rev NRP 4-26-85

CONFIDENTIAL

1. SCOPE

This specification describes a glass filled PTFE (TFE resin) material used primarily for gaskets, bushings, seat rings, and other special applications.

2. MATERIAL REFERENCE NOS.

(a) 0418

(b) 0449 for oxygen service and clean/handle per FGS-8A11

3. SPECIFICATIONS

(a) Composition: Virgin PTFE (TFE resin) (polytetrafluoroethylene) with 25% glass filler. Compound should contain no reprocessed (TFE) PTFE filler. Also no appreciable amount of color or tint should be added. (White, beige or light gray acceptable).

(b) Form: Bar stock, sheet or finished shape.

(c) Process: Compression molded or ram extruded.

4. APPROVED SOURCES

(a) Chicago Gasket Co.
Chicago, IL.
Compound No. 23 Ebolon

(b) Crane Packing Co.
Morton Grove, IL.
Compound No. 70006

(c) Mather Co., Fluorotec Div.
Milan, MI.
Compound No. 1-005-X-01

(d) Halogen Insulator & Seal Corp.
Elk Grove, IL.
Compound No. TF-8 (25%)

APR 26 198

MAJOR REVISION

SCRAP NO. NEW

BY WHH DEC

Upgrade nomenclature

Fisher Controls	Material Specification	No. FMS 17F16 E
		By FJS 8-4-65
FISHER	GASKET AND BUSHING MATERIAL	Appd. HB 11-8-82
		Page 1 of 1
©Fisher Controls 1982, 1984		Rev. MRP 12-9-82

CONFIDENTIAL

1. SCOPE

This specification describes a glass filled TFE resin material used primarily for gaskets and bushings, seat rings, and other special applications.

2. MATERIAL REFERENCE NOS.

(a) 0418

(b) 0449 for oxygen service and clean/handle per FCS 8A11

3. SPECIFICATIONS

(a) Composition: TFE resin (polytetrafluoroethylene) with 25% glass filler. Compound should contain no reprocessed TFE filler. Also no appreciable amount of color or tint should be added. (White, beige or light gray acceptable).

(b) Form: Bar stock, sheet or finished shape.

(c) Process: Compression molded or ram extruded.

4. APPROVED SOURCES

(a) Chicago Gasket Co.
Chicago, IL
Compound No. 23 Ebalon

(b) Crane Packing Co.
Morton Grove, IL.
Compound No. 70006

(c) Peabody Dove Co.
Houston, TX.
Fluorobrown E-120

(d) Mather Co., Fluorotec Div.
Milan, MI.
Compound No. 1-005-X-01

(e) Halogen Insulator & Seal Corp.
Elk Grove, IL
Compound No. TF-8 (25%)

JUL 18 1984
DATE

MAJOR REVISION
BY HRP CHKD [illegible] APVD [illegible]

0=0, OLD STOCK	REASON		
1 X USE	1 — SAFETY	5 — SUPPLY	
2 — REMACHINE	2 X QUAL	6 — COST	
3 — SCRAP/REWK	3 — IMPROVE	7 — MKTG/	
4 — SCRAP NOW	4 — ERROR	SALES	

ADD HALOGEN MAT'L

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

GASKET AND BUSHING MATERIAL

HQ FMS 17P16 E
ISSUED FJS 8-4-1
REV. (1-a) 9-26-7
PAGE 1 OF 1

CONFIDENTIAL

1. SCOPE
This specification describes a glass Filled TPE resin material used primarily for gaskets and bushings.

Glass Filled TPE Gasket and Bushing Material
25% Glass Filled
No Reprocessed TPE Filler
No Color or Tint Added
(White, Beige, or Light Gray Acceptable)

2. MATERIAL REFERENCE, FDS
(a) 0419
(b) 0449 for oxygen service and clean/handle per FGS 8.4.11

3. SPECIFICATIONS
(a) Composition: TPE resin (polytetrafluoroethylene) with 25% glass fiber. Compound shall contain no reprocessed TPE filler. Also no appreciable amount of colorant should be added. (White, beige or light gray acceptable).

Approved Sources and Material Specifications:

Chicago Gasket Co.
Chicago, Illinois
#22 Ebelon

Crane Packing Co.
Morton Grove, Illinois
Matl. No. 70006

John L. Pore Co.
Houston, Texas
Flonrobrown E-120

Marbar Company, Fluorotec Division
Milan, Michigan
Resin X-105

Sparta Manufacturing Co.
Dover, Ohio
Fluorospax 725D

(b) Form: Bar stock, sheet or finished shape.
(c) Process: Compression molded or ram extruded.

4. APPROVED SOURCES
(a) Chicago Gasket Co.
Chicago, IL.
Compound No. 22 Ebelon
(b) Crane Packing Co.
Morton Grove, IL.
Compound No. 70006
(c) Peabody Pore Co.
Houston, TX.
Flonrobrown E-120
(d) Marbar Co. Fluorotec Div.

NOV 17 1982

MAJOR REVISION DATE
BY CHKD APVD TKB
CHG. OLD STOCK / ENG. REASON
1 & USE 4 — SAFETY 5 — STOCK
2 — RELEASURE 2 — LIATE 6 — COST
3 — SCRAP/NEW 3 — IMPROVE 7 — MKTG/SALES
4 — SCRAP NOW 8 — ERROR
Revised to current specification

Fisher Controls

Material Specification

FLUORINATED ETHYLENE PROPYLENE RESIN (FEP)

PLASTIC, FEP

delete

FISHER

No.	FMS 17FI2	C
By	PMK	1-16-64
Apvd	TKB	11-8-82
Page	1 of 1	
Rev	2 PM	11-8-82

©Fisher Controls 1982, 1990

CONFIDENTIAL

1. SCOPE

This specification describes a general purpose (fluorinated ethylene propylene (FEP)) resin material used in a variety of applications, such as, bearings, valve discs, valve stem packings, wipers, diaphragm protectors and valve linings. In general, FEP and (PTFE) have similar chemical resistance, however FEP has a lower upper temperature limit and is less porous than (PTFE) due to its melt processability.

PTFE

PTFE

2. MATERIAL REFERENCE NO. 0648

3. SPECIFICATIONS

(a) Composition: Material compounded of unfilled FEP resin (fluorinated ethylene propylene)

delete

Note: material may contain inorganic coloring.

(b) Form: Standard rod, tube or finished shapes. It is usually not available in sheet form.

(c) Process: Injection molded or melt extruded.

(d) Typical Physical Properties

Tensile strength @ 73°F, ASTM D638	3000 psi
Hardness, ASTM D2240 (Type D)	57 to 60
Deformation under load, 1200 psi, 122°F, 24 hrs., ASTM D621	6%
Water Absorption, ASTM D570	< 0.01%
Flammability, UL94	V-0

4. APPROVED MATERIAL

DuPont Co.
Teflon FEP

MAJOR REVISION

ECR/H NO. _____ DATE SEP 07 1990

BY WRH CHKD DJE APVD NFR

REQ. OLD STOCK
1 — ISSUE
2 — REVISION
3 — ECR/H/WITH
4 — SCRAP NOW

REVISION: 0 — ENGR REASON; 1 — SAFETY; 2 — MATL; 3 — IMPROVE; 4 — LEGAL; 5 — STDTN; 6 — COST; 7 — MKTG/SALES

change title, all reference to PTFE

Fisher Controls | Material Specification | FMS 17F11

POLYCHLOROTRIFLUOROETHYLENE
MOLDED PRODUCTS

Rev: G
By: RKB 4-25-62
Apvd: NFR 9-11-87
Page 1 of 1

FISHER

©Fisher Controls 1987, 1991 | Revised By: WHH 10-10-91

CONFIDENTIAL

1. SCOPE

This specification covers polychlorotrifluoroethylene (CTFE) products used primarily as ball valve seals, valve discs or seats, diaphragm protectors, and gaskets.

12 References
a) ASTM D638 - Test Method for Tensile Properties of Plastics
b) ASTM D790 - Test Methods for Flexural Properties of Reinforced and Unreinforced Plastics
c) ASTM D2240 - Test Method for Rubber Property Durometer Hardness

2. MATERIAL REFERENCE NO.

0507
06CA for oxygen service, clean and handle per FGS 6A11
053L water quenched with minimum Zero Strength Temperature of 320°F

3. SPECIFICATIONS

(a) Composition: Unplasticized polychlorotrifluoroethylene conforming to ASTM D1430-81, Type I, Grade 1, Class C.

(b) Form: Sheet or molded parts

(c) Process: Melt extrusion or compression molded

(d) Typical physical properties:

Tensile strength @ 73° F, ASTM, D638	5000 psi
Elongation-at-fail @ 73° F, ASTM D638	175%
Flexural modulus @ 73° F, ASTM D790	250,000 psi
Hardness @ 73° F, ASTM D2240 (Type D)	76

4. APPROVED MATERIALS

FEB 10 1998

(a) 3M Co.
St. Paul, MN
Kel-F 81, Type 6060 or 6061

(b) Daikin-Kogyo Co.
Osaka, Japan
Daiflon CTFE, Type M-400H

MAJOR REVISION
EGRN No. 961398 Date 9-11-97
By AMK Chkd DHN Apvd TOG

840. Old Stock
1_ UBE
2_ REWORK
3_ SCRAP/NEW
4_ SCRAP NOW

EGRN
830. Reason
1_ SAFETY
2_ MATL
3_ IMPROVE
4_ ERROR
5_ STDZN
6_ COST
7_ UNITY SALES

Updated to the new electronic format. Any changes in appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGE TO CONTENT.
ADDED REFERENCE

Fisher Controls | Material Specification | FMS 17F11

FISHER

POLYCHLOROTRIFLUOROETHYLENE MOLDED PRODUCTS

Rev: (D) EL
By: RKB 4-26-62
Apvd: NFR 9-11-87
Page 1 of 1

*Fisher Controls 1987

Revised By: WHH 10-24-8

CONFIDENTIAL

1. SCOPE

This specification covers polychlorotrifluoroethylene (CTFE) products used primarily as ball valve seals, valve discs or seats, diaphragm protectors, and gaskets.

2. MATERIAL REFERENCE NO.

0507
06CA for oxygen service, clean and handle per FGS 8A11

3. SPECIFICATIONS

(a) Composition: Unplasticized polychlorotrifluoroethylene conforming to ASTM D1430-81, Type 1, Grade 1, Class C.

(b) Form: Sheet or molded parts

(c) Process: Melt extrusion or compression molded

(d) Typical physical properties:

Tensile strength @ 73° F, ASTM, D638	5000 psi
Elongation-at-fail @ 73° F, ASTM D638	175%
Flexural modulus @ 73° F, ASTM D790	250,000 psi
Hardness @ 73° F, ASTM D2240 (Type D)	76

4. APPROVED MATERIALS

(a) 3M Co.
St. Paul, MN
Kel-F 81,Type 6060 or 6061

(b) Daikin-Kogyo Co.
Osaka, Japan
Daiflon CTFE, Type M-400H

SEP 26 1988

MAJOR REVISION

ECR/N NO. _____ DATE
BY WHH CHKD DRB APVD NFR
GEN. VAL. STOCK ADD. PLANTS
1 X YES 5 — STOCK
2 — REMARK 1 — SAFETY 6 — COST
3 — SCRAP/USE 2 — MAIL 7 — MKTG/
4 — SCRAP HOW 3 X IMPROVE SALES
4 — ORDER

Add new compound number.

CONFIDENTIAL

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17F11 (B)
	Kel-F Molded Sheet, LOX Grade POLYCHLOROTRIFLUOROETHYLENE MOLDED PRODUCTS	ISSUED DKB 4-26-62 REV. MCT 11-30-62 PAGE 1 OF 1

1. SCOPE

This specification covers polychlorotrifluoroethylene (CTFE) products used primarily as ball valve seats, valve discs or seats, diaphragm protectors, and gaskets.

2. MATERIAL REFERENCE No.

0507

3. SPECIFICATIONS

(a) Composition: Unplasticized polychlorotrifluoroethylene conforming to ASTM D 1430-81, Type I, Grade 1, Class C.

(b) Form: Sheet or molded parts

(c) Process: Melt extrusion or compression molded.

Kel-F Molded Sheet
Kel-F 81 Grade 3
For Lox Service
Unplasticized — delete.

(d) Typical physical properties:

Tensile strength @ 73°F, ASTM D638	5000 psi
Elongation-at-fail @ 73°F, ASTM D638	175%
Flexural modulus @ 73°F, ASTM D790	250,000 psi
Hardness @ 73°F, ASTM D2240 (Type D)	76

Approved Sources
Allied Nucleonics Corporation — delete

4. APPROVED MATERIALS

(a) 3M Co.
St. Paul, MN
Kel-F 81, Grade 6060

(b) Daikin-Kogyo Co.
Osaka, Japan
Daiflon CTFE, Type M-400H

MAJOR REVISION
ECR/N NO. _____ DATE OCT 0 2 1987
BY WHN CHKD DKB APVD NFR

TAYLOR V. 3.M. COMPANY ET AL.
ROA_03770

Fisher Controls | Document Cover Sheet | RMS 17Q24

SILICONE RUBBER GASKET MATERIAL

Revi. K
By: WHR 8-13-84
APVD: NFR 8-14-84
Page 0.1

FISHER

CONFIDENTIAL

*Fisher Controls 1984, 1991

Revised By: WHR 8-23-91

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	K						
1	J						
2	G						
3	E						
4	B						

MAJOR REVISION
ECRN No. 91-1398 Date 4/16/97
By DM Chkd PMD Apvd TGS

MAY 18 1998

000, On Stock
1 _JOB
2 _ REWORK
3 _ SCRAP/NEW
4 _ SCRAP NOW

Explain

100, Reason
1 _ SAFETY
2 _ MATL
3 _ IMPROVE
4 _ ERROR
6 _ STDZN
8 _ COST
7 _ MKTG/ SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

TAYLOR V. 3 M COMPANY ET AL

CONFIDENTIAL

Fisher Controls	Material Specification	No. EMS 17624	F
FISHER	SILICONE RUBBER GASKET MATERIAL	By DZ 5-1-58	
		Appd NFR 8-14-84	
		Page 1 of	
©Fisher Controls		Rev NRP 8-13-84	

1. SCOPE

This specification applies to rubber materials to be used as gaskets under adverse ambient temperature conditions, and in contact with air, natural gases, or other specialized services. Silicone rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal air (or gas) pressures not in excess of 100 psig. The material usually would be used in applications where the control assemblies are subject to high or low ambient temperatures. The gaskets are generally used in specialized applications, and the normal service life of the assembly may be as much as 15 years or more without inspection or repair.

2. MATERIALS REFERENCE NOS. 0414 & 10447 for oxygen service per FGS BA11 (BA15) Delete. Delete

3. BASIC MATERIAL AND PARTS

Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or at the end of this specification. The thickness tolerance of the sheet or cut gaskets shall be as follows:

Standard 1/64" thick - 0.016" ±.002"
1/32" thick - 0.031" ±.003"
1/16" thick - 0.062" ±.005"

4. SURFACE AND GENERAL QUALITY

The finished surfaces of the sheet or cut gaskets shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 18 x to 20 x magnification.

5. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of -60°F to +400°F.

FMS2-3/1
Ptr. #5

MAJOR REVISION DATE JAN 10 1990
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION G TO H

TAYLOR V. 3 M. COMPANY ET AL

CONFIDENTIAL

FISHER Control
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SYNTHETIC RUBBER GASKET MATERIAL

NO. FMS 17G24 (7)
ISSUED D E 5-1-58
REV. 20 7-10-75
PAGE 2 OF 2

12. Dimensional Tolerances - The thickness tolerance of the sheet or cut gaskets shall be as follows:

Standard 1/64" thick - 0.016" ±.002"
1/32" thick - 0.031" ±.003"
1/16" thick - 0.062" ±.005"

13. Cold Temperature Resistance - Material must not be brittle after 5 hours at -90°F. Hardness must not exceed 90 Durometer A at -60°F. The hardness increase between 75°F and -60°F shall not be greater than 10 points Durometer A on any given sample.

14. Compression and Recovery - After loading a 1/2" thickness of the material to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 6.5% of the original.

15. Aging Qualities - The material must have excellent aging qualities. After oven aging for 7 days at 350°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 10%. The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

16. Qualification Testing - Items 3 through 15 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

17. Quality Control - Items 3, 4, 5, 6, and 12 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

18. Approved Materials - The following materials are considered as approved for production use under this specification.

A. (DuPont) No. (SS-0070) (Silicone).

AUG 21 1984

FAIRPRENE

SS-5570

CHANGE DuPont TO FAIRPRENE. RETYPED

MAJOR REVISION DATE
BY NRP CHKD WJH APVD NPR

ROA_03773

TAYLOR W. 3 M. COMPANY ET AL

CONFIDENTIAL

FISHER

TABLE 1
QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (1)
Hardness	FOS 11A1	Shore "A" Durometer	70±5
Basic Material	—	—	See Section 3
Resilience	FOS 11A2	Bashore	40±10
Surface and General Quality	FOS 11A9	—	See Section 4

Note: (1) All properties measured at 70°±5° F.

AUG 29 1991
MAJOR REVISION DATE
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION H TO J

TAYLOR-V-3 M COMPANY ET AL

CONFIDENTIAL

Fisher Controls	Material Specification	No. FMS 17624	A
FISHER	SILICONE RUBBER GASKET MATERIAL	By WHH 8-13-84	
		Appd NFR 8-14-84	
		Page 3 of	
©Fisher Controls		Rev	

TABLE 1

QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "A" Durometer	77±5 70±5
Basic Material	---	---	See Section 3
Resilience	FGS 11A2	Dashore	40±10
Surface and General Quality	FGS 11A9	--	See Section 4

FMS2-3/3

JAN 16 1990

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION G TO H

CONFIDENTIAL

Fisher Controls | Document Cover Sheet | FMS 17G10

NEOPRENE RUBBER MATERIAL
75-95 DUROMETER A HARDNESS

Rev: (N)P
By: KJS 09-13-95
Apvd: MFR 11-28-94
Page 0.1

1-16-96

©Fisher Controls 1982, 1996 Revised By: TDG (1-11-96)

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	(N)P						
1	K						
1.1	[illegible]						
1.2	(N)B						
2	[illegible]						
3	[illegible]						
4	[illegible]						

MAJOR REVISION
ECRN No. 96 0050 Date 1-18-96
By TDG Chkd DEB Apvd

Explain: 1 X USS; 2 _ REWORK; 3 _ SCRAP/NEW; 4 _ SCRAP NOW; 5 _ SAFETY; 6 _ MATL; 7 _ IMPROVE; 8 _ ERROR; 9 _ BTOZN; 10 _ COST; 11 _ MKTG/SALES

Remove confidential formulation

JAN 25 1996

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF: UNDERWRITERS LABORATORIES

CONFIDENTIAL

Fisher Controls | Document Cover Sheet | FMS 17G10

NEOPRENE RUBBER MATERIAL
85-95 DUROMETER A HARDNESS

Rev: (D) M
By: PJS 09-13-52
Apvd: NFR 11-26-84
Page 0.1

FISHER

©Fisher Controls 1982, (1990) 1991 | Revised By: WHH 4-11-90 8-23-91

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	(L) M						
1	J						
2	K						
3	B						
4	(C) D						

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF: UL

AUG 29 1991

MAJOR REVISION

ECR/N NO. _____ DATE

BY WHH CHKD BJE APVD NFR

560. OLD STOCK	630. REASON	
1 USE	1 SAFETY	5 OTHER
2 REWORK	2 MATL	6 COST
3 SCRAP/REW	3 APPROVE	7 MKTG?
4 SCRAP NOW	4 ERROR	

EXPLAIN

Add hardness change

CONFIDENTIAL

Fisher Controls — Document Cover Sheet — FMS 17G10

NEOPRENE RUBBER MATERIAL
85-95 DUROMETER A HARDNESS

Rev: (K) L
By: PJG 09-13-52
Apvd: NPR 11-26-84
Page 0.1

FISHER

Fisher Controls 1982, (1987) 1990 — Revised By: WRH 9-17-8(9)

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	(K) L	>	>	>	>	>	>
1	(H) J	>	>	>	>	>	>
2	(G) K	>	>	>	>	>	>
3	B	>	>	>	>	>	>
4	C	>	>	>	>	>	>
>	>	>	>	>	>	>	>
>	>	>	>	>	>	>	>
>	>	>	>	>	>	>	>
>	>	>	>	>	>	>	>
>	>	>	>	>	>	>	>
>	>	>	>	MAJOR REVISION		>	(19)
>	>	>	ECR/N NO.	DATE		>	
>	>	>	BY WRH CHKD PSD APVD JPC			>	LP >
>	>	>	SCRAP/REWORK: 1 — OBS. OLD STOCK 2 — MISC. 3 — REWORK 4 — SCRAP/REW 5 — SCRAP NOW	ENG. REASON: 1 — SAFETY 2 — LEGAL 3 — IMPROVE 4 — ERROR	5 — GIVEN COST 6 — 7 — ALTER/SALES	>	>
>	>	>	> Add anhydrous ammonia			>	
>	>	>	> to scope, update color code to conform to			>	>
>	>	>	> new systems			>	>
>	>	>	>	>	>	>	>
>	>	>	>	>	>	>	>
>	>	>	>	>	>	>	>

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table above shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF: UL

CONFIDENTIAL

Fisher Controls | Material Specification | JAN 17 1984 | FMS 17G10

NEOPRENE RUBBER MATERIAL,
85-95 DUROMETER A HARDNESS

Rev: (5) K
By: PJS 09-13-52
Apvd: NFR 11-26-84
Page 1

TOS 1-11-94

FISHER

*Fisher Controls

Revised By: WHH 9-11-92

1. SCOPE

This specification applies to rubber materials to be used as valve seat discs or gaskets which will be in contact with commercial Propane and Butane vapors and liquid, natural gas, anhydrous ammonia vapor and liquid, and all impurities normally contained in these fluids. Molded or cut parts made from materials approved under this specification are used as seat discs or gaskets in pressure regulators and valves which control the flow of various fluids. The discs are generally of circular shape and are attached to or contained in a metal holder. The part serves to form a tight shutoff seal, usually seating against a rather sharp-edged metal orifice which may tend to cause cutting or severe indentation of the rubber. The assembly is used in a system where the parts may be subjected to a maximum of 300 psig gas pressure. The normal service life of the assembly may be as much as 15 years or more without inspection or repair.

1.2 This standard includes references to the following documents:

2. MATERIALS REFERENCE NO. 0303

a) FES 1141 ...
b) FES 1142 ...
c) FES 1143
d) FES 1144
e) FES 1145

f) FES 1146
g) FES 1150

3. BASIC MATERIAL

Synthetic rubber molded or cut in the form of circular shaped discs of various thicknesses and diameters, and molded or lathe-cut rings of several shapes, thicknesses and diameters. Parts may be required to have manufacturer's identification markings as may be designated on detail drawings or at the end of this specification.

3.1, 3.2, 3.3 (See attached sheet)

5. (4.) SURFACE AND GENERAL QUALITY

The finished surfaces of the molded parts shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense and free from porosity and other imperfections when a cut edge is viewed under 18x to 20x magnification. Molded undercuts such as "snap-on discs" must not have any cracks or tears resulting from stripping the disc from the mold.

When ground with a suitable grinding wheel, the resulting ground surface shall be a smooth, non-porous surface.

6. (5.) SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of -40°F to +180°F.

MAJOR REVISION DATE 1-11-94
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION M TO N

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 and 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

The letters "G10" shall be printed on one face of each flat seat disc when the size of the part will allow. Printing color for each supplier shall be as listed below. Other identification where required for parts shall be as noted on the part drawing.

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Palmor Laboratories, Inc. AT64-R(1) (Neoprene) - identification color, tan..

(b) Minnesota Rubber Co. 570A (Neoprene) - identification color, silver (may also have sprue dot on back side).

delete

OCT 0 2 1987

MAJOR REVISION (DATE)
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION J TO K

TAYLOR V. 3 M COMPANY ET AL

CONFIDENTIAL

Fisher Controls **Document Cover Sheet** FMS 17G10 (H)

FISHER

By PJS 9-13-82
Appd NPR 11-26-84
Page 0.1 of

©Fisher Controls 1982, 1986 Rev NEP 8-6-86

Title:

NEOPRENE RUBBER MATERIAL
85-95 DUROMETER A HARDNESS

Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level
0.1	(H) J						
1	G						
2	(G) H						
3	B						
4	B						

MAJOR REVISION
ECN/R NO. DATE
BY WHH CHKD NPR APPD
ENG. RELEASE
OLD STOCK
REWORK
SCRAP/REPAIR
OBSOLETE
1 2 3 4 5 6 7 8
8 — OTHER
a) Delete Green Mat'l. - No longer available
b) Change color code

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF: UL

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table above shows the revision level of each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

CONFIDENTIAL

Fisher Controls	Material Specification	No. FMS 17010	C
FISHER	NEOPRENE RUBBER MATERIAL 85-95 DUROMETER A HARDNESS	By FJS 9-13-51	
		Appd NRP 11-24-8	
		Page 1 of	
©Fisher Controls		Rev NRP 11-19-86	

1. SCOPE

This specification applies to rubber materials to be used as valve seat discs or gaskets which will be in contact with commercial Propane and Butane vapors and liquid and with natural gas and all impurities contained in these gases. delete ~~Contact with liquid or vapor ammonia should be avoided.~~ Molded or cut parts made from materials approved under this specification are used as seat discs or gaskets in pressure regulators and valves which control the flow of liquefied petroleum gases and natural gases. The discs are generally of circular shape and are attached to or contained in a metal holder. The part serves to form a tight shutoff seal, usually seating against a rather sharp-edged metal orifice which may tend to cause cutting or severe indentation of the rubber. The assembly is used in a system where the parts may be subjected to a maximum of 300 psig gas pressure. The normal service life of the assembly may be as much as 15 years or more without inspection or repair.

2. MATERIALS REFERENCE NO. D303

3. BASIC MATERIAL

Synthetic rubber molded or cut in the form of circular shaped discs of various thicknesses and diameters, and molded or lathe-cut rings of several shapes, thicknesses and diameters. Parts may be required to have manufacturer's identification markings as may be designated on detail drawings or at the end of this specification.

4. SURFACE AND GENERAL QUALITY

The finished surfaces of the molded parts shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 10x to 20x magnification. Molded undercuts such as "snap-on discs" must not have any cracks or tears resulting from stripping the disc from the mold.

When ground with a suitable grinding wheel, the resulting ground surface shall be a smooth, non-porous surface.

5. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of -40°F to +180°F.

FMS2-26/1

OCT 0 2 1987

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION J - 10

TAYLOR V.P.M. COMPANY ET AL

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 and 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

The letters "GIO" shall be printed on one face of each flat seat disc when the size of the part will allow. Printing color for each supplier shall be as listed below. Other identification where required for parts shall be as noted on the part drawing.

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Palmar Laboratories, Inc. AT64-R(1) (Neoprene) - identification color, green.

(b) Minnesota Rubber Co. 570A (Neoprene) - identification color, silver (may also have sprue dot on back side).

(c) Goshen Rubber Co. L754 (Neoprene) - identification color, yellow.

NOV 29 1985

ALTER QUALIFICATION REQUIREMENTS TO REFLECT STD. TESTS AND APPROVED MATLS

MAJOR REVISION
ECR/N NO. N/A DATE
BY NRP CHKD WHH APVD NFR

CONFIDENTIAL

Fisher Controls — Document Cover Sheet

FISHER

No. FMS 17610 (E)
By WHH 11-19-84
Appd NEP 11-26-84
Page 0.1 of

©Fisher Controls 1982, (1984) FMS — Rev NRP 11-19-84

Title:

NEOPRENE RUBBER MATERIAL
NOV 2 7 1985 (90-96) DUROMETER A HARDNESS
85-95

Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level
0.1	(F) G						
1	(F) G						
2	(F) G						
3	(X) B						
4	(A) B						

MAJOR REVISION
NOV 27 1985
ECR/N. NO. N/A DATE>
BY NEP CHKD WHH APVD NEP

ALTER QUALIFICATION REQUIREMENTS TO REFLECT STD. TESTS AND APPROVED MATLS

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table above shows the revision level of each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

FISHER GOVERNOR CO.
MARSHALLTOWN, IOWA
USA

MATERIAL SPECIFICATION

SYNTHETIC RUBBER DISC MATERIAL

CONFIDENTIAL

NO. FMS 47G10 E
ISSUED FJS 9-13-52
BY NRP 1-14-82
PAGE 1 OF 2

1. General - This specification applies to rubber materials to be used as valve seat discs which will be in contact with commercial Propane and Butane vapors and liquid and with natural gas and all impurities contained in these gases.

2. Scope of Application - Molded or cut parts made from materials approved under this specification are used as seat discs in pressure regulators and valves which control the flow of liquefied petroleum gases and natural gases. The discs are generally of circular shape and are attached to or contained in a metal holder. The part serves to form a tight shutoff seal, usually seating against a rather sharp-edged metal orifice which may tend to cause cutting or severe indentation of the rubber. The assembly is used in a system where the parts may be subjected to a maximum of 300 psig gas pressure. The normal service life of the assembly may be as much as 15 years or more without inspection or repair.

3. Basic Material and Parts - Synthetic rubber molded or cut in the form of circular-shaped discs of various thicknesses and diameters. Parts may be required to have manufacturer's identification markings as may be designated on detail drawings, or as listed in Section 10 of this specification.

4. Hardness - 90 to 96 Durometer A at 75°F. (76 to 82 Durometer B.)

5. Resilience - 30 ± 10 Bashore at 75°F.

6. Surface and General Quality - The finished surfaces of the molded parts shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 10x to 20x magnification. Molded undercuts such as "snap-on discs" must not have any cracks or tears resulting from stripping the disc from the mold. When ground with a suitable grinding wheel, the resulting ground surface shall be a smooth, non-porous surface.

7. Anti-Sticking Quality - The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals, when the material is pressed against these metals for long periods of time at loads up to 2500 psi.

8. Service Temperature - The material shall not deteriorate and shall function properly in the designated service at temperatures of -40°F to +160°F.

9. Tensile Strength - $1800 \pm \frac{7000}{400}$ psi at 75°F.

10. Elongation - $100 \pm \frac{100}{40}$ % at 75°F.

11. Fluid Resistance

A. Swelling - During immersion for 96 hours at 75°F with dimensional checks being made every 24 hours, the volumetric swell in Hexane shall not exceed 20%. After immersion for 120 hours at 75°F in liquid Propane, the volumetric swell shall not exceed 10%.

B. Shrinkage - The maximum volumetric shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -8%, liquid Propane, -8%.

TAYLOR V. 3.M. COMPANY ET AL.

CONFIDENTIAL

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	MCL RMS 17G10 D
	SYNTHETIC RUBBER DISC MATERIAL	ISSUED FJS 9-13-72
		REVISED 5-7-75
		PAGE 2 OF 2

Cold Temperature Resistance - Material must not be brittle after 5 hours at -70°F. Hardness must not exceed 95 Durometer B at -20°F. The hardness increase between 75°F and -20°F shall not be greater than 15 points Durometer B on any given sample.

Compression and Recovery - After loading a 1/2" thickness of the materials to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 7.5% of the original.

Cold Flow Resistance - When a disc of 5/16" Dia. by 3/16" thick is loaded to 2500 psi for 24 hrs. at 75°F, it shall not have a set of more than .020" (thickness decrease) 24 hrs. after removal of the load.

Indentation Resistance - When a disc of 5/16" Dia. by 3/16" thick is installed in a metal holder which supports both the bottom and sides of the disc and a load of 2500 psi is applied by a 5/32" Dia. flat anvil (centered on sample) for 24 hrs. at 75°F, the disc shall not show any signs of cutting nor shall it have an indentation of more than .020" immediately upon removal of the load.

16. Aging Qualities - The material must have excellent aging qualities. After oven aging for 14 days at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 25%. The material shall not be subject to surface cracking or checking under high stress static loading for long periods of time at ambient temperature.

17. Quality Control - The vendor shall conduct adequate tests (maintaining records of same) on each production batch of the material to determine that the resilience, hardness, strength, and other physical properties are maintained within proper limits. Fisher Controls Company quality control procedures apply to all of the preceeding requirements. Samples of any production batch which do not meet the requirements shall be subject to replacement by the vendor.

18. Parts Identification - The letters "G10" shall be printed on one face of each disc when the size of the part will allow. Printing color for each supplier shall be as listed below.

19. Approved Materials - The following materials are considered as approved for production use under this specification.

A. Pelmor Laboratories, Inc. A164-R(1) (Neoprene) - identification color, green.

B. Minnesota Rubber Co. 5704 (Neoprene) - identification color, silver (may also have sprue dot on back side).

C. Goshen Rubber Co. 1704 (Neoprene) - identification color, yellow.

CONFIDENTIAL

TABLE 2
ADDITIONAL QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria(3)
Tensile Strength	FGS 11A8	PSI	1400 min.
Tensile Elongation	FGS 11A9	%	60 min.
Cold Resistance	FGS 11A3		
(a) Hardness incr. RT to -40°F		Shore Duro	20 Pts. max.
(b) Hardness at -40°F		Shore Duro	95B max. or 80D max.
(c) 180° Bend at -60°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 H.	FGS 11A4 (Type A)	%	1.5% max.
Oven Aging, @ 7 days at 212°F	FGS 11A8	change in tens. str.	+25% (1)
Fluid Resistance	FGS 11A5		
(a) Liquid anhydrous Ammonia 5d, RT		Volume Swell	15% max.
+ air dry		Volume Shrink	-8% max.
Anti-Sticking Quality			See Note (2)

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration. Also, the hardness change shall not exceed + 10 points.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, die cast materials and other metals, when the material is pressed against these metals for long periods of time at loads up to 2500 PSI.

(3) All properties except cold resistance measured at: 70°±5°F.

MAJOR REVISION DATE > AUG 20 1991

CONFIDENTIAL JAN 17 1984

Fisher Controls

FISHER

Material Specification

NEOPRENE RUBBER MATERIAL
85-95 DUROMETER A HARDNESS

No. FMS 17G10 B

By WHH 11-19-84

Appd NFR 11-26-84

Page 3 of

©Fisher Controls

By NED 11-19-85

TDG 1-11-89

TABLE 1

QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (2)
Hardness	FGS 11A1	Shore Durometer A	90±5 ~~(1) or~~ 7±5 "a"
Resilience	FGS 11A2	Bashore	25±10
Surface and General Quality	FGS 11A9	--	See Section 4
Fluid Resistance	FGS 11A5		
(a) Hexane 96 hrs. at R.T. + air dry to equilibrium		Volume Swell	+20% max.
		Volume Shrink	-8% max.
(b) Liquid Propane 120 hrs. at R.T. + air dry to equilibrium		Volume Swell	+10% max.
		Volume Shrink	-8% max.

Notes:

~~(1) or 76±5 Durometer B~~

(1) (2) All properties measured at RT 70° ±5°F on 45 mil slab samples

MAJOR REVISION DATE 1-11-89
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION M TO N

TAYLOR W. 2 M COMPANY ET AL

CONFIDENTIAL

Fisher Controls

FISHER

Material Specification

NEOPRENE RUBBER MATERIAL
(70-90) DUROMETER A HARDNESS
85-95

No. EMS 17610 A

By WJH 11-19-84

Appd LFE 11-26-84

Page 3 of

©Fisher Controls

Rev

TABLE 1

QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria(2)
Hardness	FGS 11A1	Shore Durometer A	(93+3) (1) 90±5
Resilience	FGS 11A2	Bashore	(30) ±5 10
Surface and General Quality	FGS 11A9	--	See Section 4
Fluid Resistance	FGS 11A5		
(a) Hexane 96 hrs, at R.T. + air dry to equilibrium		Volume Swell	+20% max.
		Volume Shrink	-8% max.
(b) Liquid Propane 120 hrs. at R.T. + air dry to equilibrium		Volume Swell	+10% max.
		Volume Shrink	-8% max.

Notes:

90±5

(1) or (79+3) Durometer B

(2) All properties measured at 70° ±5°F

NOV 27 1985

MAJOR REVISION

ALTER QUALIFICATION REQUIREMENTS TO REFLECT STD. TESTS AND GRADES OF APPROVED MATLS

ECR/N NO. N/A DATE

BY NSP CHKD [illegible] APPD [illegible]

TAYLOR V. 3 M COMPANY ET AL

Fisher Controls | Document Cover Sheet | FMS 17Q3

NITRILE-HYPALON OR NITRILE RUBBER MATERIAL, 82-90 DUROMETER HARDNESS

Rev: 0 R
By: HW 2-9-60
Apvd: NFR 11-13-84
Page 0.1

FISHER

CONFIDENTIAL

*Fisher Controls 1982, (1991) 1992

Revised By: WHR 8-23-91
4-30-92

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	(0) R						
1	(1) M						
2	(N) P						
3	B						
4	(C) D						

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF: UL

JUN 16 1992

MAJOR REVISION

ECR/R NO. _____ DATE 4-30-92

DY WHW CHKD TDG APVD DRB

$43, OLD STOCK
1 X USE
2 __ REWORK
3 __ SCRAP/NEW
4 __ SCRAP AVD

EXPLAIN

$3A, REASON
1 __ SAFETY
2 __ MAR
3 __ IMPROVE
4 X ERROR
5 __ MARK
6 __ COST
7 __ METR/
SPECS

Moved tensile strength reading to correct column.

Added referenced specification section.

TAYLOR W. 3 M. COMPANY ET AL

FISHER

CONFIDENTIAL

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 & 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

Unless exception is noted on the part drawing, the designation "G3" shall be printed on a non-critical surface of the part. When parts are too small to allow this, a color dot shall be applied. The identification color for this specification shall be yellow.

Note: If the material specified is the standard for a particular part, then the color code requirements may be waived by Fisher Engineering.

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Pelmor Laboratories, Inc. A252-NH-H (Nitrile-Hypalon)

MAJOR REVISION DATE 4-30-92
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION 20 TO 21

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 & 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

7. QUALITY CONTROL TESTING

The tests listed in Table I shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

Unless exception is noted on the part drawing, the designation "G3" shall be printed on a non-critical surface of the part. When parts are too small to allow this, a color dot shall be applied. The identification color for this specification shall be yellow.

Note: If the material specified is the standard for a particular part, then the color code requirements may be waived by Fisher Engineering.

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Pelmor Laboratories, Inc. AB52-N3-H (Nitrile-Hypalon)

(b) Acadia Synthetic Products PB-165-85-J2 (Nitrile)

delete

MAY 02 1991

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION N TO P

CONFIDENTIAL

Fisher Controls

FISHER

Material Specification

NITRILE-HYPALON OR NITRILE RUBBER MATERIAL, 82-90 DUROMETER HARDNESS

No. FMS 1703 M1

By HW 2-9-90

Appd NFR 2-9-90

Page 2 of

©Fisher Controls

Rev NRP

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 & 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

The letters "03" shall be printed on one face of each disc or gasket when the size of the part will allow, except Pelmor Laboratories will use a printed mottled pattern. Printing color for each supplier shall be as listed below. Other identification where required shall be as noted on the part drawing.

delete

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Pelmor Laboratories, Inc. N.62-NH-H (Nitrile-Hypalon) - Identification color, green

(b) Minnesota Rubber Co., 4185 (Nitrile-Hypalon) - Identification color, silver, (may also have sprue dot on back side).

(c) Acadia Synthetic Products PB-165-86-33 (Nitrile) - Identification color, blue.

delet

MAJOR REVISION DATE > SEP 13 1990
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION M TO

FMS2-25/2

Unless exception is noted on the part drawing, the designation "03" shall be printed on a non-critical surface of the part. When parts are too small to allow this, a color dot shall be applied. The identification color for this specification shall be yellow.

Note: If the material specified is the standard for a particular part, then the color code requirements may be waived by Fisher Engineering.

TAYLOR V. 3M COMPANY ET AL

CONFIDENTIAL

Fisher Controls

Document Cover Sheet

FISHER

No. FNS 1763

By HW 8-7-90

Appd NPR 11-12-90

Page 0.1 of

©Fisher Controls 1982 1990

Rel NEP

Title:

NITRILE-HYPALON OR NITRILE RUBBER MATERIAL,
82-90 DUROMETER A HARDNESS

Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level
0.1	(1)M						
1	K						
2	(1)M						
3	B						
4	A						

SEP 19 1995

MAJOR REVISION DATE

ECR/N NO. CHKD DATE APVD APD

BY WHO

ADD. REASON

1 — SAFETY

2 — MAY JEOPARDIZE

4 — ERROR

5 — STORM

6 — COST

7 — BROKEN/FAILED

SCRAP NEW

SCRAP NOW

Update Color code to match system form

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF: UL

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table above shows the revision level of each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

CONFIDENTIAL

Fisher Controls

FISHER

Material Specification

NITRILE-HYPALON OR NITRILE RUBBER MATERIAL, 82-90 DUROMETER HARDNESS

No.	FNS 1763
By	HW 2-9-60
Apvd	NFR 11-13-84
Page	1 of
Rev.	NRP 11-12-84

WHH 11-26-90

©Fisher Controls

1. SCOPE

This specification applies to rubber materials to be used as valve seat discs or gaskets which will be in contact with air, hydrocarbon gases and liquids, and anhydrous ammonia vapor and liquid, and all impurities normally contained in these fluids. The molded or cut seat discs are generally of circular shape and are attached to or contained in a metal holder. The part serves to form a tight shutoff seal, usually seating against a rather sharp-edged metal orifice which may tend to indent and/or cut the rubber. Gaskets are generally cut from sheet stock and while usually annular in shape, can be any shape or size. These rubber parts in assembly may be subjected to pressures as high as 300 psig. The normal service life of the assembly may be as much as 15 years or more without inspection or repair.

2. MATERIALS REFERENCE NOS. - 0302

3. BASIC MATERIAL AND PARTS

Synthetic rubber molded or cut in the form of discs or gaskets of various thicknesses and sizes. Parts may be required to have manufacturer's identification markings as designated either on detail drawings or in Section B of this specificati

4. SURFACE AND GENERAL QUALITY

The finished surfaces of the molded parts shall be smooth and free of imperfections such as cracks, holes, or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 18x to 20x magnification. Molded undercuts such as "snap-on discs" must not have any cracks or tears resulting from stripping the disc from the mold. When ground with a suitable grinding wheel, the resulting ground surface shall be a smooth, non-porous surface.

5. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of (-40°F) -50°F to +180°F.

FMS2-25/1

DEC 10 1990

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION M TO N

TAYLOR V. 3.M. COMPANY ET AI

ROA_03795

CONFIDENTIAL

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 1703 (J)
	SYNTHETIC RUBBER DISC MATERIAL	ISSUED MW 2-9-60
		REV NRP 1-14-82
		PAGE 2 OF 3

B. Shrinkage - The maximum volumetric shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -5%, liquid Propane, -6%, liquid anhydrous ammonia, -6%.

12. Cold Temperature Resistance - Material must not be brittle after 5 hours at -40°F. Hardness must not exceed 95 Durometer B at -20°F. The hardness increase between 75°F and -20°F shall not be greater than 23 points Durometer B on any given sample.

13. Compression and Recovery - After loading a 1/2" thickness of the materials to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 2.5% of the original.

14. Aging Qualities - The material must have excellent aging qualities. After oven aging for 14 days at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 10%. The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

15. Quality Control - The vendor shall conduct adequate tests (maintaining records of same) on each production batch of the material to determine that the resilience, hardness, strength, and other physical properties are maintained within proper limits. Fisher Governor Company quality control procedures apply to all of the preceeding requirements. Samples of any production batch which do not meet the requirements shall be subject to replacement by the vendor.

16. Parts Identification - The letters "G3" shall be printed on one face of each disc when the size of the part will allow, except Pelmor Laboratories will use a printed mottled pattern. Printing color for each supplier shall be as listed below.

17. Approved Materials - The following materials are considered as approved for production use under this specification.

A. Pelmor Laboratories, Inc. AL62-NH-H (Nitrile-Hypalon) - Identification color, green.

B. Minnesota Rubber Co., 4185 - W(Nitrile-Hypalon) - Identification color, silver (may also have sprue dot on back side).

C. Goshen Rubber Company, 1499 (Nitrile) - Identification color, yellow.

D. Acadia Synthetic Products PB-165-85-J3 (Nitrile) - Identification color, blue.

Note - A and B are to be considered as the preferred materials under this specification. C and D are to be used as "second" source or alternate materials only, due to their hardnesses being near or at the upper limit.

NOV 22 1984

REWRITE TO BOTH UPDATE FORMAT AND MODIFY REQUIREMENTS

MAJOR REVISION BY NRP DISC WHH APVD NRP

MD CIS FILE 1 XEROX 2 - [illegible]

TAYLOR V. 3.M. COMPANY ET AI

CONFIDENTIAL

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. MS 1769 (H)
	SYNTHETIC RUBBER DISC MATERIAL	ISSUED MJH 2-9-60
		REV MJH 6-16-70
		PAGE 2 OF 2

18. Shrinkage - The maximum volumetric shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -5%, liquid Propane, -6%, liquid anhydrous ammonia, -8%.

Cold Temperature Resistance - Material must not be brittle after 5 hours at -40°F. Hardness must not exceed 95 Durometer B at -20°F. The hardness increase between 75°F and -20°F shall not be greater than 23 points Durometer B on any given sample.

Compression and Recovery - After loading a 1/2" thickness of the materials to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 2.5% of the original.

14. Aging Qualities - The material must have excellent aging qualities. After oven aging for 14 days at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 10%. The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

15. Quality Control - The vendor shall conduct adequate tests (maintaining records of same) on each production batch of the material to determine that the resilience, hardness, strength, and other physical properties are maintained within proper limits. Fisher Governor Company quality control procedures apply to all of the preceeding requirements. Samples of any production batch which do not meet the requirements shall be subject to replacement by the vendor.

16. Parts Identification - The letters "G3" shall be printed on one face of each disc when the size of the part will allow, except Palmer Laboratories will use a printed mottled pattern. Printing color for each supplier shall be as listed below.

17. Approved Materials - The following materials are considered as approved for production use under this specification.

A. Palmer Laboratories, Inc. AL62-NH-H (Nitrile-Hypalon) - Identification color, green.

B. Minnesota Rubber Co., 4185A ~~(Nitrile)~~ (Nitrile-Hypalon) - Identification color, silver (may also have sprue dot on back side).

C. Goshen Rubber Company, 1499 (Nitrile) - Identification color, yellow.

D. Acadia Synthetic Products PR-165-85-J3 (Nitrile) - Identification color, blue.

Note - A and B are to be considered as the preferred materials under this specification. C and D are to be used as "second" source or alternate materials only, due to their hardnesses being near or at the upper limit.

JAN 18 1982

TAYLOR V. 3.M. COMPANY ET AI

TABLE 2
ADDITIONAL QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FGS 11A8	PSI	1600 min.
Tensile Elongation	FGS 11A8	%	100 min.
Cold Resistance (a) Hardness Incr. RT to -30°F	FGS 11A3	Shore Duro	+24 Pts. max.
(b) Hardness at -30°F		Shore Duro	95B max. or 80D max.
(c) 180° Bend at -50°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 hrs.	FGS 11A4 (Type A)	%	2.5% max.
Oven Aging, 7 days @ 212°F	FGS 11A8 (Tens. str.)	change in	±10% (1)
Anti-Sticking Quality	—	—	See note (2) below

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration. Also, the hardness change shall not exceed +10 points.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals, when the material is pressed against these metals for long periods of time at loads up to 2500 psi.

(3) All properties except cold resistance measured at 70° ±5°F.

MAJOR REVISION DATE 4-30-92
FOR MAJOR REVISION STAMP INFORMATION SEE COVER SHEET

Fisher Controls

FISHER

Material Specification

NITRILE-HYPALON OR NITRILE RUBBER MATERIAL, 82-90 DUROMETER HARDNESS

No. FMS 17G3 (A)

By WHH 11-12-84

Appv JFR 11-13-84

Page 4 of

©Fisher Controls

Rev WHH 11-26-90

TABLE 2

ADDITIONAL QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FGS 11A8	PSI	1600 min.
Tensile Elongation	FGS 11A8	%	100 min.
Cold Resistance	FGS 11A3		
(a) Hardness Incr. RT to -20°F -30°F		Shore Duro	+24 +23 Pts. max.
(b) Hardness at -20°F -30°F		Shore Duro	95B max. *80D max.
(c) 180° Bend at -50°F -40°F after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 h.	FGS 11A4 (Type A)	%	2.5% max.
Oven Aging, 14 days, @ 212°F	FGS 11A8	change in tens. str.	+18% (1)
Anti-Sticking Quality	---	---	See note (2) below

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals, when the material is pressed against these metals for long periods of time at loads up to 2500 psi.

(3) All properties except cold resistance measured at 70° ±5°F.

FMS2-25/4

DEC 10 1990

MAJOR REVISION DATE >

FOR MAJOR REVISION STAMP INFORMATION SEE COVER SHEET

REVISION M TO N

CONFIDENTIAL

Fisher Controls | Document Cover Sheet | FMS 17G1

NEOPRENE RUBBER GASKET OR DISC MATERIAL
(78 TO 88 DUROMETER "A" HARDNESS)

Rev: A (S)
By: ZDI 12-6-46
Apvd: NFR 9-30-85
Page 0.1

FISHER

*Fisher Controls 1985, 1996 Revised By: TDG 1-18-96

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	R (S)						
1	R						
1.1	DELETED A						
1.2	A						
2	R						
3.	C						
6	R						

APR 27 1998

MAJOR REVISION
BORN No. 961398 Date 4/15/97
By DM Chkd RMD Apvd TDG
840, Old Stock
1 _ USE
2 _ REWORK
3 _ SCRAP NEW
4 _ SCRAP NOW
Explain
880, Fluegon
1 _ SAFETY
2 _ MATL
3 _ IMPROVE
4 _ ERROR
5 _ 9102N
6 _ COST
7 _ MKTG/SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Document Cover Sheet | NOV 10 1993 | FMS 17Q1

NEOPRENE RUBBER GASKET OR DISC MATERIAL (78 TO 82 DUROMETER "A" HARDNESS)

Rev: NP
By: MW 12-6-46
Apvd: MFR 9-30-85
Page 0.1

FISHER

CONFIDENTIAL

©Fisher Controls 1985, 1993

Revised By: MW 6-23-91

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of the document. A revision of this page will be made when any page of the document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	NP						
1	L						
2	KL						
3	KG						
4	ED						

MAJOR REVISION

VCR/ECN 930226 DATE 10-13-93

INT TCS CHKD TL EXPED MFR

Added Fluorel N0-5540 material as supplier option. Need to expand testing this material

Changed cold bend test to -50F as new material could not pass -60F test. No alternate supplier could be found.

TAYLOR V. 3M COMPANY ET AL

CONFIDENTIAL

FISHER

Rev: L
Dpt: MM 12-6-46
Appd: MCR 9-10-85
Page 2

*Fisher Controls — Revised By: TDG 10-13-91

5. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 and 2 prior to approval under this specification. Following approval, the vendor of each material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for requalification.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records as may be deemed necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

The letters "FC" shall be printed on one face of each disc or gasket when the size of the part will allow. Printing color for each supplier shall be as listed below. Other identification where required shall be as noted on the part drawing.

9. APPROVED MATERIALS

(a) Palmer Laboratories Inc. AM3-711 - (Neoprene)
Identification Color: Tan

(b) Acadia Synthetic Products 656-3214 - (Neoprene)
Identification Color: White

(c) Reeves Bros. - Vulcan Div. 4453A - (Neoprene)
Identification Color: Yellow Wavy Lines
Approved for Flat Sheet Goods only

(d) Fairprene Industrial Products Co., Inc. HS-8585 - (Neoprene)
Identification Color: Yellow Checkerboard Pattern
Approved for Flat Sheet Goods only

FISHER

Rev: M
Dpt: MM 12-6-
Appd: MCR 9-10-
Page 2

*Fisher Controls — Revised By: TDG 1-15-

5. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records as may be deemed necessary to insure that the required quality and consistency of properties are maintained. Required testing includes rheometry, specific gravity and tensile testing. Rheometry measurements shall include scorch point of 2 lbf-in rise above M_L (ts2), 90% cure (t'90) time, minimum (M_L) and maximum (M_H) torque values. All values must meet as signs given as established by the vendor using standard statistical process control techniques. If reversion or water-decay testing of rubber are stocked in the uncured state, rheometry must be performed before molding parts and the same criteria successfully met. Mechanical testing must also be performed on each batch of cured rubber for hardness, tensile strength, tensile modulus for each 100% of elongation, break elongation and resilience as specified in this document. Specific gravity cups also be measured and correlate with the initial qualification batch within ±0.02. Quality Control documentation is required and will be audited by Fisher's Quality Assurance Department. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

The letters "FC" shall be printed on one face of each disc or gasket when the size of the part will allow. Printing color for each supplier shall be as listed below. Other identification where required shall be as noted on the part drawing.

10. APPROVED MATERIALS

(a) Palmer Laboratories Inc. AM3-711 - (Neoprene)
Identification Color: Tan

(b) Acadia Synthetic Products 656-3214 - (Neoprene)
Identification Color: White

(c) Reeves Bros. - Vulcan Div. 4453A - (Neoprene)
Identification Color: Yellow Wavy Lines
Approved for Flat Sheet Goods Only

(d) Fairprene Industrial Products Co., Inc. HS-8585 - (Neoprene)
Identification Color: Yellow Checkerboard Pattern
Approved for Flat Sheet Goods Only

[illegible] REVISION DATE
FOR [illegible]
INFORMATION ONLY [illegible]
REVISION L

TAYLOR W M COMPANY ET AL

ROA_03802

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Table 1 & 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

The letters "G1" shall be printed on one face of each disc or gasket when the size of the part will allow. Printing color for each supplier shall be as listed below. Other identification where required shall be as noted on the part drawing.

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Pelmor Laboratories Inc. AF67-F(1) - (Neoprene)
Identification Color, Tan

(b) Acadia Synthetic Products 1856-3214 - (Neoprene)
Identification Color, Blue.

(c) Reeves Bros. - Vulcan Div. 448M - (Neoprene) Wavy Lines
Identification Color, Yellow/ Approved for Flat Sheet Goods Only
Checkerboard Pattern

(d) Fairprene Industrial Products Co., Inc. NS-5500 - (Neoprene)
Identification Color, Yellow/ Approved for Flat Sheet Goods Only

~~FMS-1572~~

MAJOR REVISION DATE 10-13-23
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION N TO P

Fisher Controls **Document Cover Sheet** CONFIDENTIAL

FISHER

1987

©Fisher Controls 1985, (1986)

Title:

No.	FMS 1761	(K)
By HW	12-6-46	
Appd MR	9-30-85	
Page 0.1	(J)	
Rev WHH	12-12-86	

NEOPRENE RUBBER GASKET OR DISC MATERIAL
(78 TO 88 DUROMETER "A" HARDNESS)

Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level
0.1	(K) L						
1	(J) K						
2	K						
3	A						
4	(A) B						

NOV 10 1987

MAJOR REVISION

ECR/N NO. _____ DATE

BY WHH CHKD MR APPD MCP

Added note on grinding jobs
added thickness tolerances within
were inadvertantly left off last revision

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table above shows the revision level of each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

CONFIDENTIAL

Fisher Controls	Material Specification	No. FMS 1761	
FISHER	NEOPRENE RUBBER GASKET OR SEAT DISC MATERIAL (78 TO 88 DUROMETER "A" HARDNESS)	By H.W.	12-6-66
		Appd JFR	9-30-85
		Page 1 of	
©Fisher Controls		Rev NRP.	9-27-85

1. SCOPE

This specification applies to rubber materials to be used as valve seat discs or gaskets which will be in contact with air, hydrocarbon gases and liquids, and anhydrous ammonia vapor and liquid, and all impurities normally contained in these fluids. The molded or cut seat discs are generally of circular shape and are attached to or contained in a metal holder. The part serves to form a tight shutoff seal, usually seating against a rather sharp-edged metal orifice which may tend to indent and/or cut the rubber. Gaskets are generally cut from sheet stock and while usually annular in shape, can be any shape or size. These rubber parts in assembly may be subjected to pressures as high as 300 psig. The normal service life of the assembly may be as much as 15 years or more without inspection or repair.

2. MATERIALS REFERENCE NOS. - 0301

3. BASIC MATERIAL AND PARTS

Synthetic rubber molded or cut in the form of discs or gaskets of various thicknesses and sizes. Parts may be required to have manufacturer's identification markings as designated either on detail drawings or in Section 8 of this specification. Tolerances on sheet stock furnished for die cutting of parts shall be as follows: 1/32" thick ±.005"; 1/16" thick ±.010"; and 3/32" or 1/8" thick ±.014".

4. SURFACE AND GENERAL QUALITY

The finished surfaces of the molded parts shall be smooth and free of imperfections such as cracks, holes, or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 18x to 20x magnification. Molded undercuts such as "snap-on discs" must not have any cracks or tears resulting from stripping the disc from the mold. When ground with a suitable grinding wheel, the resulting ground surface shall be a smooth, non-porous surface.

5. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of -40°F to +180°F.

FMS3-15/1

NOV 10 1987
MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INSERT ON DISCOVERER SHEET
IT WAS K ... IS L

TAYLOR V. 3.M. COMPANY ET AI

CONFIDENTIAL

FISHER Control
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

SYNTHETIC RUBBER GASKET OR DISC MATERIAL

NO. FMS 17G2 | BY K.W. 12-6-78 | APVD | PAGE 2 OF 2 | REV NAP 12-8-79

B. Shrinkage - The maximum volumetric shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -4%; liquid Propane, -4%.

12. Cold Temperature Resistance - Material must not be brittle after 5 hours at -40°F. Hardness must not exceed 95 Durometer B at -40°F. The hardness increase between 75° F and -40°F shall not be greater than 24 points Durometer on any given sample.

13. Compression and Recovery - After loading a 1/2" thickness of the materials to 400 psi at 75°F for 24 hours and allowing it to recover without load for 20 hours, the thickness shall return to within 1.5% of the original.

14. Aging Qualities - The material must have excellent aging qualities. After oven aging for 168 hours at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 25%. The material shall not be subject to surface cracking or checking under high stress static loading for long periods of time at ambient temperature.

15. Qualification Testing - Items 3 through 14 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

16. Quality Control - Items 3, 4, 5, 8, and 11 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

17. Parts Identification - The letters "GI" shall be printed on one face of each disc when the size of the part will allow. Printing color for each supplier shall be as listed below.

18. Approved Materials - The following materials are considered as approved for production use under this specification.

A. Pelmor Laboratories Inc. AF67-F(1) - Neoprene) - identification color, green.

B. Acadia Syn.Products 185E-3214 (Neoprene) - identification color, blue.

C. Reeves Bros. - Vulcan Division 4451R(Neoprene) - identification color, yellow. Used for sheet goods only (gaskets, etc.) (Not approved for molded items such as seat discs, etc.)

OCT 8 1985

MAJOR REVISION

ECR/N NO. A2487 DATE

ADD MATL REF NO
UPDATE FORMAT - ADDED COVER SHT &

BY MEP CHKD APVD NER

ROA_03806

TAYLOR W & M COMPANY ET AL

CONFIDENTIAL

Fisher Controls, Marshalltown, Iowa	MATERIAL SPECIFICATION	NO. FMS 1701 G
	SYNTHETIC RUBBER GASKET OR DISC MATERIAL	BY R.W. 12-6-76
		APVD
		PAGE 2 OF 2
		REV LMS 10-5-76

B. Shrinkage - The maximum volumetric shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -4%; Liquid Propane, -4%.

12. Cold Temperature Resistance - Material must not be brittle after 3 hours at -40°F. Hardness must not exceed 95 Durometer B at -40°F. The hardness increase between 75° F and -40°F shall not be greater than 24 points Durometer on any given sample.

13. Compression and Recovery - After loading a 1/2" thickness of the materials to 400 psi at 75°F for 24 hours and allowing it to recover without load for (24) 20 hours, the thickness shall return to within (22) 1.5 of the original.

14. Aging Qualities - The material must have excellent aging qualities. After oven agin for 168 hours at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 25%. The material shall not be subject to surface cracking or checking under high stress static loading for long periods of time at ambient temperature.

15. Qualification Testing - Items 3 through 14 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

16. Quality Control - Items 3, 4, 5, 6, and 11 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

17. Parts Identification - The letters "GI" shall be printed on one face of each disc when the size of the part will allow. Printing color for each supplier shall be as listed below.

18. Approved Materials - The following materials are considered as approved for production use under this specification. AF67-F(1)

A. Palmer Laboratories Inc. (AF67-D) (Neoprene) - identification color, green.

B. Acadia Syn.Products 185B-3214 (Neoprene) - identification color, blue.

C. Reeves Bros. - Vulcan Division 4451R(Neoprene) - identification color, white. Used for sheet goods only (gaskets, etc.). (Not approved for molded items such as seat discs, etc.) 12-10-77

YELLOW

MAJOR REVISION DATE
BY NRC CHANGED APVD TKS
DISP. OLD STOCK — DISP. REVISED
1 ☒ USE — 1 — SAME — 3 — STOCK
2 — DISCONTINUE — 2 ☒ NEW
3 — SCRAP/RETURN — 3
4 — SCRAP NEW — 4 — OTHER

B. Shrinkage - The maximum volumetric shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -4%; liquid Propane, -4%.

12. Cold Temperature Resistance - Material must not be brittle after 5 hours at -40°F. Hardness must not exceed 96 Durometer B at -40°F. The hardness increase between 75°F and -40°F shall not be greater than 24 points Durometer B on any given sample.

13. Compression and Recovery - After loading a 1/2" thickness of the materials to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within (5%) of the original.

14. Aging Qualities - The material must have excellent aging qualities. After oven aging for 168 hours at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 25%. The material shall not be subject to surface cracking or checking under high stress static loading for long periods of time at ambient temperature.

Qualification Testing - Items 3 through 14 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

Quality Control - Items 3, 4, 5, 6, and 11 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

17. Parts Identification - The letters "GT" shall be printed on one face of each disc when the size of the part will allow. Printing color for each supplier shall be as listed below.

18. Approved Materials - The following materials are considered as approved for production use under this specification.

A. Palmer Laboratories Inc. AF67-D (Neoprene) - identification color, green.

B. Acadia Syn. Products 185E-3214 (Neoprene) - identification color, blue.

C. Reeves Bros. - Vulcan Division 4451R (Neoprene) - identification color, white. Used for sheet goods only (gaskets, etc.). (Not approved for molded items such as seat discs, etc.)

ENGINEERING DEPT. DATE 12-6-76
MAJOR REVISION
BY LMS CHECKED APPD Ltd.
DISPOSITION OF OLD STOCK
Change is considered No. Replacement Compound No. Longer available

EXCISION PRINT REMOVE FROM ENGINEERING FILES

CONFIDENTIAL

FISHER

ECONOMIC RUBBER COMPOUND OR
NON-MISC MATERIAL
(TO BE IN DURONETER "A" HARDNESS)

Rev: G
Dft: KAT 9-27-85
Appvd: MFR 9-30-85
Page 4

*Fisher Controls

Revised By: TVG 10-23-85

Table 2

Additional Qualification Tests

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FCS 1154	PSI	1200 min.
Tensile Elongation	FCS 1154	%	100 min.
COLD RESISTANCE	FCS 1153		
(a) Hardness incr. RT to -40°F		Shore Duro	+20 Pts. max
(b) Hardness at -40°F		Shore Duro	950 max.
(c) 180° Bend at -50°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 h.	FCS 1152 (Type A)	%	2.5% max.
Oven Aging, 7 days, @ 212°F	FCS 1153	change in tens. str.	25% (1)
Anti-Sticking Quality	—	—	See note (2) below

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration. Also, the hardness change shall not exceed +10 points.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals when the material is pressed against these metals for long periods of time at loads up to 2500 psi. The finishing treatment to produce the anti-sticking quality should not leave any permanent visible solid deposit on the material surface.

(3) All properties except mold resistance measured at 70 ± 5°F.

FISHER

NEOPRENE RUBBER COMPOUND OR
NON-MISC MATERIAL
(TO BE IN DUROMETER "A" HARDNESS)

Rev: E
Dft: KAT 9-27-85
Appvd: MFR 9-30-85
Page 4

*Fisher Controls

Revised By: TVG 10-23-85

TABLE 2

Additional Qualification Tests

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FCS 1154	PSI	1200 min.
Tensile Elongation	FCS 1154	%	100 min.
Cold Resistance	FCS 1153		
(a) Hardness incr. RT to -40°F		Shore Duro	+20 Pts. max
(b) Hardness at -40°F		Shore Duro	950 max.
(c) 180° Bend at -50°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 h.	FCS 1152 (Type A)	%	2.5% max.
Oven Aging, 7 days, @ 212°F	FCS 1153	change in tens. str.	25% (1)
Anti-Sticking Quality	—	—	See note (2) below

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration. Also, the hardness change shall not exceed +10 points from room temperature (RT) values.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals when the material is pressed against these metals for long periods of time at loads up to 2500 psi. The finishing treatment to produce the anti-sticking quality should not leave any permanent visible solid deposit on the material surface.

(3) All properties except mold resistance measured at RT=70±5°F.

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET.
REVISION 2 TO 3

TAYLOR V. 3.M. COMPANY ET AL.

ROA_03809

CONFIDENTIAL

Fisher Controls — Material Specification

FISHER

NEOPRENE RUBBER GASKET OR
SEAT DISC MATERIAL
(75 TO 78 DUROMETER "A" HARDNESS)

Rev: A
By: NRF 9-27-85
Apvd: HTK 9-30-85
Page 3

Fisher Controls — Revised By: TDC 10-15-93

TABLE 1

Quality Control & Qualification Tests

Property	Test Method	Units of Measurement	Criteria[1,2]
Basic Material	—	—	See Section 3
Hardness	FCS 11A1	Shore "A" Durometer	83±5 or 63±5 Shore "D"
Resilience (1)	FCS 11A2	Bashore	20 min.
Surface and General Quality	FCS 11A9	—	See Section 4
Fluid Resistance (a) Butane 96 hrs., RT	FCS 11A5	Volume Swell	+20% max.
+ 96 hr. air dry		Volume Shrink	-4% max.
(b) Liquid Propane 120 hrs., RT		Volume Swell	+12% max.
+ 120 hr. air dry		Volume Shrink	-4% max.

Notes:

(1) All properties measured at 70±5°F

Fisher Controls — Revised By: TDC 3-15-

TABLE 1

Quality Control & Qualification Tests

Property	Test Method	Units of Measurement	Criteria[1,2]
Basic Material	—	—	See Section 3
Hardness	FCS 11A1	Shore "A" Durometer	83±5 or 63±5 Shore "D"
Resilience (1)	FCS 11A2	Bashore	20 min.
Surface and General Quality	FCS 11A9	—	See Section 4
Fluid Resistance (a) Butane 96 hrs., RT	FCS 11A5	Volume Swell	+20% max.
+ 96 hr. air dry		Volume Shrink	-4% max.
(b) Liquid Propane 120 hrs., RT		Volume Swell	+12% max.
+ 120 hr. air dry		Volume Shrink	-4% max.

Note:

(1) All properties measured at 70±5°F

MAJOR REVISION DATE
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION 2 TO 3

TAYLOR W & M COMPANY ET AL
ROA_03810

Fisher Controls

FISHER

Material Specification

NEOPRENE RUBBER GASKET OR SEAT DISC MATERIAL
(78 TO 88 DUROMETER "A" HARDNESS)

No. FMS 17G1 (Q)

By NRP 9-27-85

Appd NFS 9-30-85

Page 4 of

©Fisher Controls

Rev

TABLE 2
ADDITIONAL QUALIFICATION TESTS

CONFIDENTIAL

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FGS 11A8	PSI	1200 min.
Tensile Elongation	FGS 11A8	%	100 min.
Cold Resistance	FGS 11A3		
(a) Hardness Incr. RT to -40°F		Shore Duro	+24 Pts. max.
(b) Hardness at -40°F		Shore Duro	95@ max.1
(c) 180° Bend at -60°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 h.	FGS 11A4 (Type A)	%	1.5% max.
Oven Aging, 7 days, @ 212°F	FGS 11A8	change in tens. str.	20% (1)
Anti-Sticking Quality	---	---	See note (2) below

NOV 10 1987

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION K TO L

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals, when the material is pressed against these metals for long periods of time at loads up to 2500 psi.

(3) All properties except cold resistance measured at 70° ± 5°F.

The finishing treatment to produce the anti-sticking quality should not leave any permanent visible solid deposit on the material surface.

Fisher Controls | Material Specification | FMS 17F53

FEP (FDA) COATED METAL GASKET MATERIAL

Rev: B
By: WHH 4-20-89
Apvd: JFA 4-25-89
Page 1 of 1

FISHER

*Fisher Controls 1989 | Revised By:

1. SCOPE

This standard covers DuPont Teflon FEP coated metal sheet materials used for compliance with current FDA (U.S. Food and Drug Administration) regulations.

2. MATERIAL REFERENCE NOS.

9924 S31603/FEP

3. MATERIAL DESCRIPTION

Cold rolled annealed metal sheet, as specified in Sec. 2, coated with DuPont 959-205 brown Teflon-S primary coat followed by several applications of DuPont Teflon FEP 856-200 .001" to .002" per surface. Adhesion should be equal to or greater than the strength of the FEP coating.

4. APPROVED SOURCES

(a) K & L Precision Plastics
Richardson, TX

FEB 10 1998

*FMS1-12

MAJOR REVISION
ECRN No 961398 Date 9/9/97
By MK Chkd PnD Apvd TDG
B10, Old Stock
1_USE
2_REWORK
3_SCRAP/NEW
4_SCRAP NOW
Explain
B30, Reason
1_SAFETY 6_STDZN
2_MATL 6_COST
3_IMPROVE 7_MKTG/SALES
4_ERROR

Updated to the new electronic form. Any changes to appearance, paragr numbering, etc., were to accomodate the new document format style. The appearance of the document will no be the same as before. NO CHANGE TO CONTENT.

MATERIALS FOR FDA REQUIREMENTS

Rev: B C
By: WHH 1-24-89
Apvd: NFR 1-24-89
Page 1 of 1

FISHER

*Fisher Controls 1989

Revised By: WHH 2-8-89

1. SCOPE

This specification lists sources for Fisher components which have polymeric content known to qualify for compliance with current FDA (U.S. Food and Drug Administration) regulations.

2. MATERIAL REFERENCE NUMBERS

Listed in parenthesis under Approved Materials (See Section 3 below).

3. APPROVED MATERIALS

(a) O-Ring

Parker Seal Cpd. No. E1028-70, ethylene-propylene rubber, 70A Durometer (065Y)

(b) Back-Up Ring

Pelmor Labs. Cpd. No. AJ86-E, ethylene-propylene rubber, 75A Durometer (052X)

(c) Ball Seal

Virgin unfilled UHMWPE (Ultra High Molecular Weight Polyethylene) Dixon Industries Cpd. Pennlon or Fluorocarbon Fluoroloy GU or 26. (051A)

(d) Spring Loaded Seal Ring

Fluorocarbon N10276 spring with virgin unfilled UHMWPE cover, Fluoroloy GU or compound 26. (994W)

(e) Flat Fluorocarbon Coated Gasket

K & L Precision Plastics (purchased through Cooper Mfg.) S31603 coated with DuPont 959-205 brown Teflon-S primary coat followed by several applications for DuPont Teflon FEP 856-200. The coating procedure shall be according to guidelines recommended by DuPont Company. (9924) FMS 17F53

(f) Spiral Wound Gasket

Flexitallic S31600 with virgin unfilled PTFE filler, DuPont's Teflon 7A or 8A. (994X)

MAJOR REVISION
ECR/E NO. _____ DATE MAY 11 1989
BY WHH CHKD TDG APVD NFR
FROM FMS 17F53

FMS5-12/1

Fisher Controls | Material Specification | FMS 17P49

FISHER

METAL FOIL INSERT GRAPHITE
GASKET MATERIAL
FOR OXYGEN SERVICE

Rev: A B
By: WHA 10-27-87
Apvd: NFR 10-27-87
Page 1 of 1

©Fisher Controls 1987

Revised By:

CONFIDENTIAL

1. SCOPE

This document describes a metal foil reinforced sheet graphite material with inorganic passivating corrosion inhibitor used for oxygen service gasketing.

2. MATERIAL REFERENCE NO. 994P

3. SPECIFICATIONS

(a) Composition: Graphite, ≥ 95% with S31600 foil insert, 0.002 inches thick.

Graphite contains uniformly distributed non-metallic inorganic passivating corrosion inhibitor.

(b) Special Handling: Handle and package per FCS 0All for oxygen service.

(c) Thickness: 0.031 ± .003 inches
or 0.062 ± .006 inches.

(d) Density: 70 lbs/cu. ft. graphite only.

(e) Max. temperature limits: 800°F oxidizing media
1500°F inert media

4. ACCEPTED SOURCES

(a) Union Carbide
Carbon Products Div.
Cleveland, OH
Style No. TG-285 (GTK Grafoil with metal foil insert)

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc, were to accomodate the new document format/style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

FEB 10 1998

MAJOR REVISION
EORN No. 961393 Date 2-11-97
By JM Chkd GND Apvd TDG
D40, Old Stock
1_USE
2_REWORK
3_SCRAP/NEW
4_SCRAP NOW
Explain
830, Reason
1_SAFETY
2_MATL
3_IMPROVE
4_ERROR
5_STDZN
6_COST
7_MKTG/SALES

Fisher Controls	Material Specification	No. FMS 17F48	A
FISHER	FLEXIBLE GRAPHITE SHEET WITH CORROSION INHIBITOR GASKET MATERIAL (± 0.030" delete)	By WHH 4-2-87	
		Appd NFR 4-2-87	
		Page 1 of 1	
©Fisher Controls 1987, 1988		Rev	

CONFIDENTIAL

1. SCOPE.

This document describes a flexible graphite material with inorganic passivating corrosion inhibitor to be used in gasket applications.

2. MATERIAL REFERENCE NOS. (0469)

(a) 0469

(b) 0471 for oxygen service (See Note 1)

3. SPECIFICATIONS

(a) Thickness Tolerances 0.010" ± 0.003"
0.030" ± 0.002"

(b) Composition

(1) Graphite 95% minimum

(2) Ash 5% maximum

(3) Contains uniformly distributed non-metallic inorganic passivating corrosion inhibitor

JN - 2 1988

4. TYPICAL PROPERTIES

(a) Nominal Density 70 lb/cu. ft.

(b) Sublimation Point 6500°F

MAJOR REVISION
ECR/N NO. _____ DATE
BY WHH CHKD RLF APVD NFR
0=O. OLD STOCK 1 X USE 2 — STRENGTH 3 — SCRAP/WITH 4 — SCRAP NOW
REASON: 1 — SAFETY 2 — MAINT. 3 X IMPROVE 4 — ERROR 5 — STORM 6 — COST 7 — CONTRACT SALES
Add MRN for oxygen service, plus note on packaging.
Also tolerances for .010" ± .010" thick

5. ACCEPTED SOURCE

Union Carbide Corporation
Carbon Product Division

Trade Name - GTX Grafoil

Note 1. Gasketing must be packed in sealed clean plastic bags or envelopes, which will prevent contamination and which are marked on the outside of the package. Marking should read "This gasketing is clean, free from oil or other contamination, and is suitable for oxygen service"

Signed _____ Inspector

CONFIDENTIAL

Fisher Controls | Material Specification | FMS 17F46

METAL FOIL INSERT GRAPHITE GASKET MATERIAL

Rev: 0 J
By: PBH 11-8-85
Apvd: NFR 11-8-85
Page 1 of 1

FISHER

*Fisher Controls 1985, 1994

Revised By: TDG 3-24-93
6-3-94

1. SCOPE

This document describes a metal foil reinforced sheet graphite material, typically used for gasketing.

2. MATERIAL REFERENCE NO.

994E - Standard
994Y - Certified less than 100 ppm leachable chloride per FMS 17F43.

3. SPECIFICATIONS

(a) Composition: Graphite, ≥ 95% with 531600 foil insert, 0.002 inches thick.

(b) Thickness (for reference only): 0.031, 0.062 & 1.250 ± .005 inches.

(c) Density: 70 lbs/cu. ft. graphite only.

(d) Max. temperature limits: 800°F oxidizing media*
1500°F inert media

*Note: For oxygen service use FMS 17F49

4. ACCEPTED SOURCES

(a) UCAR Carbon Co., Inc.
Cleveland, OH
Style No. GHR

(b) EGC Enterprises, Inc.
Mentor, OH

(c) Flexitallic Gaskets Co.
8440 Remington Ave.
Pennsauken, NJ 08110

(d) Flexitallic, Inc.
6915 La Porte Rd.
Deer Park, TX 77536
(713) 479-3431

MAJOR REVISION JUN 14 1994
ECR/N NO. 94D912 DATE 6-3-94
BY TDG CHKD TLG APVD NFR
BSO, BID STOCK BSO, REARUN
1 USE 1 SAFETY 5 STOCK
2 CURRENT 2 MAT 6 COST
3 OBSOLETE/NEW 3 IMPROVE 7 CONTR/SALES
4 SCRAP NOW 4 ERROR

Added secondary location

TAYLOR V. 3.M. COMPANY ET AL

FBI NICS

National Instant Criminal Background Check System
Federal Bureau of Investigation
Post Office Box 4278
Clarksburg, West Virginia 26302-4278

Transmittal Request for Final Disposition or Police Report

NTN 100M8SM6G

To:	*From:*
Agency: Spartanburg Co General Ses	Examiner: Wanda W
ATTN:	Supervisor: A. Crumbliss
Phone: 864-596-2591	Phone: 1-877-324-6427, ext. #3046257926
FAX: 864-596-2259	FAX: 1-888-550-6427 (Toll Free)
	E-mail: wawhite@fbi.gov

Date Faxed: 05/17/18 Created Date: 05/17/18

No. Pages: 2 including cover page

Special Handling Instructions: The pages following this cover sheet contain Personally Identifiable Information (PII).

WHY DOES NICS EXIST?

The Brady Handgun Violence Prevention Act (Brady Act) requires that background checks be conducted through the National Instant Criminal Background Check System (NICS) to determine whether a prospective firearms transfer would violate federal or state law. The Brady Act does not prohibit the transfer of a firearm after three business days unless information is received that dictates the transfer of the firearm should not take place. **Please Note: A firearm may be transferred to a prohibited person if a final response is not received within three business days of the NTN creation date (initial NICS inquiry).**

WHAT CAN I DO TO HELP?

Please provide disposition information on the attached Final Disposition Report (Form NICS-1) or furnish a copy of the police report attached Police Report Request (NICS-MCDV form) and return it to the attention of the NICS Examiner and Supervisor listed above. Thank you for your help.

WHAT IF I DO NOT HAVE THE INFORMATION YOU NEED?

Should you be unable to furnish this information, please indicate below the person or agency which may be able to provide the information requested.

00000001639103

Please return this document with any additional documentation.

WARNING

Information attached to this cover sheet is U.S. Government property. If you are not the intended recipient of this information, disclosure, reproduction, or distribution, use of this information is prohibited. (18 U.S.C. § 641) Please notify the originator or the local FBI office immediately to arrange for proper disposition.

FM-0013

R-84 (Rev. 08-31-1999) **FINAL DISPOSITION REPORT**

Leave Blank

Note: This vital report must be prepared on each individual whose arrest fingerprints have been forwarded to the FBI

Criminal Justice Information Services Division without final disposition noted thereon. If no final disposition is available to arresting agency, complete left side and forward the form when case referred to prosecutor and/or courts. Agency on notice as to final disposition should complete this form and submit to: **FBI, CJIS Division, Clarksburg, WV 26306.**

FBI UCN
697759PC7

Final Disposition & Date
(If convicted or subject pleaded guilty to lesser charge, include this modification with disposition.)

Name on fingerprint Card Submitted to FBI
Last First Middle

young, charles,

Date of Birth **03/04/1989** Sex **M**

Henry Fingerprint Classification From FBI 1-B Response

State Bureau No. (SID)
SC01742613

Social Security No. (SOC)
248778343

This Form Submitted By:
(Name, Title, Agency, ORI No., City & State)

Signature Date

Title

Contributor of Fingerprints (Include complete name and location of agency together with ORI number.)
SC0420300 DUNCAN PD

Arrest No. (OCA)
21086FH

Date Arrested or Received
12/09/2009

☐ COURT ORDERED EXPUNGEMENT:
Certified or Authenticated Copy of Court Order Attached.

Offenses Charged at Arrest
CARRY CONCEALED WEAPON

Please provide the charge of conviction or the court docket. The state record only shows convicted of City Ord and we need the convicting charge and state statute.

Thank you

00000001639103

Please return this document with any additional documentation.

Obsolete HRN	Description	Alternative(s)
0114	Braided asbestos with graphite.	See alternatives for 011F.
0115	Braided asbestos with graphite.	See alternatives for 011F.
0116	Molded carbon filled PTFE.	Use 95% carbon filled PTFE V-ring packing (HRN:019V).
0118	Braided asbestos with PTFE suspensoid - oxygen service.	See alternatives for 011N.
0121	Braided asbestos with Inconel wire.	Use (1) graphite ribbon/filament system. (HRN's: 0110 & 0190) or (2) Braided composition packing with Inconel wire (HRN:0188). Note 1: Graphite system will require a different packing arrangement drawing. Note 2: If obsolete packing was used as a conductive ring, then graphite filament packing (HRN:0190) should be used.
0122	Braided asbestos jacket with mica.	See alternatives for 011F.

Fisher Controls

OBSOLETE PACKING MATERIAL REFERENCE NUMBERS AND SUGGESTED ALTERNATIVES

11B5281
Page 10
Rev B
Drawn By: WHH 9-23-87
Checked By: 9-25-87
Approved: 9-29-87

FISHER

*Fisher Controls — Revised By: WHH 11-19-90

ICIEIMISI

Obsolete MRH	Description	Alternative(s)
0107	Braided asbestos with PTFE suspensoid.	See alternatives for 0107.
0108	Braided PTFE, no lubricant, for oxygen service.	Use PTFE molded V-ring packing certified for oxygen service. (MRH 0211 or MRH 0176). Note: A different packing arrangement drawing will be required.
0108	Braided asbestos & Inconel wire jacket over asbestos core with high temperature lube.	See alternatives for 0121.
0116	Braided asbestos jacket over asbestos core with wire finish.	See alternatives for 0116.
0120	Braided asbestos & Inconel wire jacket over asbestos core with wire finish.	See alternatives for 0121.
0100	Plastic packing containing PTFE powder, graphite and synthetic binder with braided PTFE yarn cover.	See alternatives for 0107.
0182	Braided asbestos jacket with asbestos and PTFE core.	See alternatives for 0107.

FISHER

*Fisher Controls

Revised By:

Obsolete MRN	Description	Alternative(s)
019A	Braided asbestos & Inconel wire over asbestos core with graphite.	See alternatives for 012L.
019D	Braided PTFE packing.	See alternatives for 011N.
019E	Plastic PTFE packing.	See alternatives for 011C.
019F	Braided PTFE packing.	See alternatives for 011C.
019G	Braided packing containing asbestos, Inconel wire and Molybdenum disulfide.	See alternatives for 012L.
019K	Braided asbestos & Inconel wire jacket over asbestos & graphite core.	See alternatives for 012L.
019L	PTFE packing.	See alternatives for 011C.

Fisher Controls

OBSOLETE PACKING MATERIAL REFERENCE NUMBERS AND SUGGESTED ALTERNATIVES

11B5251
Page 13
Rev: A
By: [illegible] 9-22-87
Chkd: PAB 9-21-87
Apvd: AFE 9-24-87

FISHER

*Fisher Controls

Revised By:

Obsolete MRN	Description	Alternative(s)
0169	Braided asbestos packing with PTFE suspensoid for oxygen service.	See alternatives for 011H.
0170	Asbestos jacket over asbestos, rubber, graphite and glycerol lubricant core.	See alternatives for 011F.
0173	Square braided asbestos rope.	Use fiber glass rope packing or graphite braided packing (MRN:0190).
0174	Braided asbestos & Inconel wire jacket over asbestos and graphite core.	See alternatives for 0121.
0179	Braided blue African asbestos with graphite.	See alternatives for 011F.
018C	Braided asbestos, Inconel wire & tungsten disulfide jacket over asbestos and graphite core.	See alternatives for 0121.

TAYLOR-V-A M COMPANY ET AL

Fisher Controls

OBSOLETE PACKING MATERIAL REFERENCE NUMBERS AND SUGGESTED ALTERNATIVES

11B5261
Page 11
Rev: A
By: WHM 7-25-87
Chkd: DRG 7-29-87
Apvd: HPE 7-30-87

FISHER

*Fisher Controls — Revised By:

Obsolete MRN	Description	Alternative(s)
0153	Aluminum & asbestos strands spiraled over an asbestos core with graphite finish.	See alternatives for 0106.
0154	Aluminum & asbestos strands spiraled over an asbestos core with mica finish.	See alternatives for 0106.
0156	Braided asbestos with PTFE suspensoid.	See alternative for 0107.
0157	Braided asbestos jacket over asbestos, binder & graphite core with corrosion resisting additives.	If application is rotary valve, use die formed grahite ribbon packing with corrosion inhibitor (MRN 013X). If sliding stem, see alternatives for 0106.
0159	Square braided asbestos with PTFE suspensoid.	See alternatives for 0107.
0160	Plastic packing consisting of graphite, asbestos and binder.	See alternatives for 011F.

ROA_03823

Fisher Controls

11B5231
Page 9
Rev: A
By: MH 4-27-87
Chkd: PAD 4-29-87
Apvd: MK 4-24-87

OBSOLETE PACKING MATERIAL REFERENCE NUMBERS AND SUGGESTED ALTERNATIVES

FISHER

Fisher Controls — Revised By:

Obsolete MRP	Description	Alternative(s)
0138	Braided blue African asbestos with graphite & high temperature lubricant.	See alternatives for 0117.
0140	Braided asbestos & monel wire jacket with asbestos & graphite core.	See alternatives for 0121.
0141	Braided asbestos with PTFE suspension.	See alternatives for 0107.
0142	Braided asbestos, inconel wire jacket with asbestos graphite core.	See alternatives for 0121.
0145	Braided PTFE with PTFE suspension.	See alternatives for 011C.
0146	Molded PTFE with 25% glass fiber-wedge seal.	Use PTFE with fiberglass filler molded V-ring packing (MRP: 0130). Note: This will require a different packing arrangement drawing.

ROA_03824

Fisher Controls

OBSOLETE PACKING MATERIAL REFERENCE NUMBERS AND SUGGESTED ALTERNATIVES

1185281
Page 7
Rev! A
By: WHH 9-29-87
Chkd: PAG 9-30-87
Apvd: JJK 9-24-87

FISHER

©Fisher Controls

Revised By:

Obsolete Key	Description	Alternative(s)
0123	Braided asbestos with mica.	See alternatives for 0112.
0124	Braided asbestos & monel wire jacket with mica & asbestos core.	See alternatives for 0121.
0125	Braided asbestos with heat resistant coating.	See alternatives for 0112.
0126	Braided asbestos with monel wire and graphite.	See alternatives for 0121.
0127	Braided asbestos with oils.	See alternatives for 0112.
0128	Braided asbestos & inconel wire jacket with asbestos, graphite core.	See alternatives for 0121.
0129	Braided blue African asbestos with PTFE suspensoid.	See alternatives for 0107.

ROA_03825

Fisher Controls

11B5281
Page 4
Rev: A
By: WH 4-23-87
Chkd: DRB 4-23-87
Apvd: WFA 4-24-87

OBSOLETE PACKING MATERIAL REFERENCE NUMBERS AND SUGGESTED ALTERNATIVES

FISHER

*Fisher Controls

Revised By:

Obsolete KRM	Description	Alternative(s)
011F	Plastic packing with asbestos, lead and graphite.	Up to 450°F Use (1) PTFE molded V-ring packing (KME:0101, etc.) or (2) molded composition packing (KME:0107). Note: use of V-ring packing will require a different packing arrangement drawing. Above 150°F - use alternatives for 0106.
011G	Braided asbestos packing with tungsten disulfide coating.	See alternatives for 0106.
011H	Braided asbestos with PTFE suspensoid.	See alternatives for 0107.
011J	Braided PTFE yarn with PTFE suspensoid + oil.	See alternatives for 011C.
011K	Braided blue African asbestos with PTFE suspensoid.	See alternatives for 0107.

Fisher Controls

Document Cover Sheet

FISHER

OBSOLETE ASBESTOS-CONTAINING PACKING

No. 1010000 D

By GDL 2-10-86

Appvl KRM 2-10-86

Page 1 of 1

Effective Controls 1986 | G | E | F | D | L | H | H | Q | S | Rev 2D5 3-28-90

Title | T | U | VJ | YK | YR |

OBSOLETE

Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level
1	B						
2	A						
3	B						
4	B						
5	B						
6	B						
7	A						
8	A						
9	C						
10	C						

OBSOLETE
SUPERSEDED BY 118526J

This page is the cover sheet of all documents containing 0 or more pages of specifications. The table above shows the revision level of each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

Fisher Controls

FISHER

OBSOLETE ASBESTOS-CONTAINING PACKING

No. 1089000 C
By CDL 2/12/86
Appd KEH 2/13/86
Page 9 of
Rev ECO 3/6/86

©Fisher Controls

OBSOLETE

SUGGESTED ALTERNATIVES

Material Reference Number	Alternative Material Reference Number * Asbestos Containing Materials	Non-Asbestos Containing Materials
0104	-	010H
0105	0105	010T
0106	0106	0194
0110	-	010R
0114	0105	010T
0122	018P	
0124	010Q	
0128	019K	0185
0135	018Q	
0136	019K	0185
0142	019K	0185
0156	0104	018R
0167		011M
0167	019K	0185
018C	019K	0185
0184	019K	0185
0188		0190, 019A [Sliding Stem Applications] 0118, 011L [Rotary Applications]

* See page 10 for description.

89-12/4

Printed in U.S.A.

Fisher Controls

FISHER

OBSOLETE ASBESTOS-CONTAINING PACKING

No.	1089000	B
By	CDL	2/10/86
Appd	KEH	2/10/86
Page	5	of

©Fisher Controls

Rev	LCD	8/6/86

OBSOLETE

OBSOLETE PART NUMBERS

G1344001352	0135	G81503K9012	0122	H1434401282	0128
G1344101352	0130	G81960X0012	0142	H1438201672	0167
G1344201352	0135	G81961K9012	0142	H1438901262	0126
G1344301352	0135	G82158K7012	0182	H1439401282	0129
G1344401352	0136	G82161K0012	0180	H1439901252	0126
G1344501352	0136	G82162K0012	0180	H1441201222	0122
G1344601352	0136	G82533K0012	0180	H1441301242	0124
G1344701292	0129	G82882K0012	0142	H1466901342	0134
G1344801292	0129	H1008401252	0126	H1467101222	0122
G1344901292	0129	H1097101262	0126	H1467201242	0124
G1345001292	0129	H1097201282	0128	H1476701622	0162
G1345101292	0120	H1105901672	0167	H1476901342	0134
G1345201292	0129	H1124601572	0157	H1490301352	0135
G1345801292	0129	H1149K0012	0167	H1498901142	0114
G1345901292	0129	H1160281282	0128	H1502301262	0126
G1346501242	0124	H1186401252	0126	H1502401512	0151
G1347301222	0122	H1186501332	0131	H1506201262	0126
G1347901232	0123	H1280401672	0167	H1806301262	0126
G1998001292	0129	H1294601672	0167	H1815801262	0126
G1998101292	0129	H1806301272	0127	H1827901262	0126
G1998201382	0138	H1208401262	0126	H1828701262	0126
G1998301382	0138	H1224701282	0128	H1840601262	0126
G1998401362	0136	H1224801312	0131	H1861001422	0142
G1998501382	0138	H1236301222	0122	H1861101422	0142
G1998801312	0131	H1236401232	0123	H1861201262	0126
G1999001272	0127	H1273601292	0129	H1896001422	0142
G1999101272	0127	H1273101282	0128	H1899001662	0166
G1999201272	0127	H1291701292	0129	H1899001252	0125
G1662201362	0136	H1301601282	0128	H1899001312	0131
G1662201362	0136	H1304001282	0128	H1791301102	0110
G1680701232	0123	H1304101282	0126	H1792901362	0136
G1680801222	0122	H1314801312	0131	H1792901662	0166
G163904K0012	0157	H1316001282	0128	H1834601362	0136
G1676901422	0142	H1320701142	0114	H1834601882	0184
G1677201432	0142	H1320801142	0114	H1838201362	0136
G1731201232	0122	H1351501362	0126	H1838262X0012	0186
G1806901382	0138	H1351SX0012	0186	H1853101672	0167
G1832501242	0124	H1370301342	0134	H1863201362	0136
G1846101592	0159	H1370901682	0160	H1863201672	0167
G1930901672	0167	H1375501342	0134	H1863301672	0167
G193909K0012	0187	H1376901342	0134	H1904301672	0167
G1970701202	0120	H1421701142	0114	H1918501662	0166
861602X0012	0124	H1422001142	0114	H1933601342	0134

Fisher Controls

FISHER

OBSOLETE ASBESTOS-CONTAINING PACKING

No. 1DD9000 B

Dr CJL 2/12/86

Appd KGM 2/13/86

Page 3 of

©Fisher Controls

Qty 200 8/6/86

OBSOLETE

OBSOLETE PART NUMBERS

0N0006011102	0110	1D7491Q1142	0114	1E3190X0162	0121
0T0532011102	0110	1D7491Q1382	0136	1E3190X0172	0167
0Y0602K0012	0110	1D7491Q1672	0167	1E3190X0182	0194
10A2235X012	0173	1D7491X0012	0113	1E3190X0192	0105
10A2837X012	0173	1D7491X0022	0186	1E3190X0202	0167
10A4855X012	0173	1D7496Q1062	0105	1E3190X0212	0186
10A5874X012	0173	1D7496X00A2	0161	1E3190X0292	0182
10A5874X0A2	0136	1D7518X0052	0107	1E3190X0242	0195
14A0916X062	018C	1D7618X0062	0140	1E3190X0252	0168
14A0916X082	0136	1D7518X0082	0134	1E3190X0272	0150
14A0916X092	0134	1D7518X0092	0136	1E3190X0288	0188
14A0915X062	018C	1D7618X00A2	0161	1E3190X0292	011F
14A0910X102	0168	1D7518X0102	0157	1E3190X0302	0110
14A1939X062	0136	1D7618X0112	0106	1E3190X0312	0179
1BA0301X012	0190	1D7618X0142	0180	1E3190X0372	011H
1A6988X0022	0110	1D7618X0162	018C	1E3190X0402	018C
1D7474Q1052	0105	1D7618X0192	0142	1E3190X0462	0141
1D7474Q1142	0114	1D7518X0202	018K	1E3190X0482	0104
1D7474Q1362	0136	1D7519Q1052	0105	1E3190X049Z	0107
1D7474X0012	0114	1D7520Q1102	0110	1E3191Q01422	0142
1D7474X00A2	0142	1D7620Q102	0161	1E3191X0052	0107
1D7475Q1052	0105	1D7620X0082	0136	1E3191X0062	0140
1D7475Q1142	0114	1D7620X0092	0140	1E3191X0072	0141
1D7475Q1362	0136	1D7620X00A2	0167	1E3191X0092	0134
1D7475X0012	0114	1D7620X0102	0134	1E3191X01D2	0136
1D7476X00A2	0142	1D7620X0122	0167	1E3191X01P2	0129
1D7484Q1052	0105	1D7620X0142	0186	1E3191X0152	0167
1D7485Q1052	0105	1D7620X0182	018C	1E3191X0162	0167
1D7487Q1052	0105	1D7620X0202	0188	1E3191X0172	0186
1D7487Q1142	0114	1D7866X0012	0110	1E3191X0182	0186
1D7487Q1342	0134	1D7587Q1102	0110	1E3191X0192	0182
1D7487Q14D2	0140	1D7868Q1102	0110	1E3191X0202	0161
1D7488X0012	0142	1D7589Q1102	0110	1E3191X0212	0194
1D7491X0022	0187	1D7590Q1102	0110	1E3191X0222	0198
1D7498Q1062	0105	1E0320X00A2	0108	1E3191X0232	0150
1D7498Q1142	0114	1E3190Q1422	0142	1E3191X0242	0168
1D7490Q1052	0105	1E3190X0052	0110	1E3191X0252	0116
1D7490Q1142	0114	1E3190X0062	0136	1E3191X0292	019J
1D7490Q1362	0136	1E3190X007Z	0134	1E3191X0322	018C
1D7490Q167Z	0167	1E3190X0092	0107	1E3191X0362	0116
1D7490X0012	0110	1E3190X0102	0129	1E6656X0022	0136
1D7490X0022	0186	1E3190X0112	0140	1E6656X0032	0194
1D7491Q1052	0105	1E0190X0132	0161	1F5370X0022	0142

89-13/1-11

ROA_03830

Fisher Controls

FISHER

OBSOLETE ASBESTOS-CONTAINING PACKING

No.	1089000	A
By	CDL	2/10/86
Appr		2/10/86
Page	7	of
Rev		

Fisher Controls

DESCRIPTION OF OBSOLETE MATERIALS

OBSOLETE

Material Reference Number	Vendor	Description
0107	FMS 17D10	ASBESTOS, BLUE, TFE
0108	FMS 17D4	ASBESTOS
0110	CRANE SUPERSEAL 3	ASBESTOS, GRAPHITE
0113	UNSPECIFIED	ASBESTOS, MICA
0114	CRANE 177-17	ASBESTOS, GRAPHITE
0116	GARLOCK 103	ASBESTOS, GRAPHITE
0117	CRANE 709	ASBESTOS, TFE
0117	ACE-O-PAX 1	ASBESTOS, LEAD, GRAPHITE
0118	ACE-O-PAX 1124	ASBESTOS, TUNGSTEN DISULPHIDE CTD
011H	GARLOCK 8080	ASBESTOS, TFE
011K	GARLOCK 8290	ASBESTOS, BLUE APRICAM
011N	GARLOCK 8780	ASBESTOS/TFE, OXYGEN SERVICE
011P	JM A-2024	ASBESTOS/TFE, OXYGEN SERVICE
0121	UNSPECIFIED	ASBESTOS, INCONEL
0122	ACE-O-PAX 5	ASBESTOS, MICA
0123	ACE-O-PAX 90	ASBESTOS, MICA, LUBE
0124	ACE-O-PAX 6NJ	ASBESTOS, MONEL, MICA
0125	ACE-O-PAX 16	ASBESTOS
0126	CRANE 187	ASBESTOS, MONEL, GRAPHITE
0127	ACE-O-PAX 7	ASBESTOS, MICA
0128	ACE-O-PAX 4JJ1	ASBESTOS, INCONEL, GRAPHITE
0129	CHEMPRO 600	ASBESTOS, BLUE, TFE
0131	ACE-O-PAX 820A	ASBESTOS, ALUMINUM
0133	ACE-O-PAX 28	ASBESTOS, BLUE, GRAPHITE
0134	GARLOCK 256	ASBESTOS, GRAPHITE
0135	ACE-O-PAX 630	ASBESTOS, INCONEL, MICA
0136	CRANE 187-1	ASBESTOS, INCONEL, GRAPHITE
0137	ACE-O-PAX 9	ASBESTOS, LEAD, MICA
0138	ACE-O-PAX 30	ASBESTOS, BLUE, GRAPHITE
0140	CRANE 6-AM	ASBESTOS, MONEL, GRAPHITE
0141	CRANE 6-98	ASBESTOS, TFE
0142	CRANE 177-A1	ASBESTOS, INCONEL, GRAPHITE
0145	GARLOCK 5800	DON-SEE 019F-ASBESTOS, WHITE
0147	ACE-O-PAX 13	ASBESTOS, GRAPHITE
0148	ACE-O-PAX 14	ASBESTOS, GRAPHITE, LUBE
0149	CHEMPRO 5000S	ASBESTOS, WHITE, TFE
0150	JM CHEMPAC 2011	ASBESTOS, WHITE
0151	JM 255	ASBESTOS, GRAPHITE
0152	JM 14	ASBESTOS, GRAPHITE, COPPER

85-12/2

Form 3031 Printed in U.S.A.

Fisher Controls | Material Specification | FMS 30A4

THERMOPLASTIC POLYESTER

Rev: (B) C
By: DJW 2-5-81
Apvd: BR 2-6-81
Page 1 of 1

FISHER

CONFIDENTIAL

©Fisher Controls 1981 (1989) 1992 — Revised By: WHH (6-1-89) 4-30-92

1. SCOPE

This is a basic description of thermoplastic polyester used for molded plastic parts.

2. MATERIAL REFERENCE NUMBER: 051Y (QMAT)

Valox 311-1001 dry colored in Fisher green is a polyester which consists of Valox 325 base resin with an ultraviolet-inhibitor.

2. (3) MATERIAL REFERENCE NUMBER: 051Y

3. MATERIAL DESCRIPTION
Valox 311-8051 is a polyester which consists of Valox 325 base resin with an ultraviolet-inhibitor in standard gray.

4. SOURCE

(a) General Electric Co. G.E. Plastics
Pittsfield, MA

JUN 3 1992

4-30-92

Deleted Fisher green colored Valox. It is no longer used.

CONFIDENTIAL

Fisher Controls | Material Specification | FMS 17N5

CORROSION INHIBITED FLEXIBLE GRAPHITE FILLED SPIRAL WOUND GASKETS

Rev: D/E
By: RJF 8-14-87
Apvd: MFR 8-14-87
Page 1 of 1

FISHER

©Fisher Controls 1990, 1994

Revised By: TDG 6-3-94

1. SCOPE

This specification lists the approved source for spiral wound gaskets constructed from metal windings with sheet gasket filler material, their general usage and product name. The sheet gasket filler cannot contain any form of asbestos.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with flexible graphite used as a filler. The flexible graphite filler shall contain a uniformly distributed non-metallic inorganic passivating corrosion inhibitor. The flexible graphite originates as Union Carbide's GTK Grafoil.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-500 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee: (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, (3) compliance to load/compression characteristics per Fisher drawings, and (4) compliance to this specification.

6. APPROVED SOURCE(S)

APR 27 1998

The following material has been approved for all spiral wound gaskets:

Metal windings with flexible graphite filler containing a uniformly distributed non-metallic inorganic passivating corrosion inhi

(a) Flexitallic Gasket Company, Inc.
8440 Remington Ave.
Pennsauken, New Jersey 08110
(609) 931-2500

(b) Flexitallic, Inc.
6915 LaPorte Rd.
Deer Park, TX 77536
(713) 479-3491

MAJOR REVISION
SORN No. 961358 Date 4-24-97
By MLH Chkd PMD Apvd TDG
440. Old Stock
1_USE
2_REWORK
3_SCRAP/NEW
4_SCRAP NOW
830. Reason
1_SAFETY 5_STDZN
2_MATL 6_COST
3_IMPROVE 7_MKTG/
4_ERROR

Updated to use new electronic format. Any changes to appearance, paragraph numbering, etc. were made to the new document. ... appearance of the document will not be

Fisher Controls | Material Specification | JAN 15 1993 | FMS 17N5

CORROSION INHIBITED FLEXIBLE GRAPHITE FILLED SPIRAL WOUND GASKETS

Rev: B C
By: RJP 5-14-87
Apvd: NFR 8-14-87
Page 1 of 1

FISHER

CONFIDENTIAL

*Fisher Controls ~~1987, 1998~~ 2

Revised By: ~~MRH 11-28-90~~ TOG 12-11-92

1. SCOPE

This specification lists the approved source for spiral wound gaskets constructed from metal windings with sheet gasket filler material, their general usage and product name. The sheet gasket filler cannot contain any form of asbestos.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with flexible graphite used as a filler. The flexible graphite filler shall contain ~~barium molybdate as a corrosion inhibitor.~~ uniformly distributed metallic inorganic passivating corrosion inhibitor. The flexible graphite originates at Union Carbide GTE Control.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-500 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee, (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, (3) compliance to load/compression characteristics per Fisher drawings, and (4) compliance to this specification.

6. APPROVED SOURCE(S)

The following material has been approved for all spiral wound gaskets:

(a) Metal windings with flexible graphite filler containing ~~barium~~ uniformly distributed nonmetallic inorganic ~~molybdate as a~~ corrosion inhibitor.

Flexitallic Gasket Company, Inc.
8440 Remington Ave.
Pennsauken, New Jersey 08110
(609) 931-2500

PMIT See Back of This Page

NOTE: ~~No change in material or vendor as stated in this specification is allowed without prior approval of General Electric~~

Flexitallic is ceasing to make its own flexible graphite. They will be buying from Union Carbide, who uses a different corrosion inhibitor.

MAJOR REVISION
ECR/N NO. B4644 DATE 12-11-92
BY TOG CHKD DRR APVD NFR

CONFIDENTIAL

Fisher Controls | Material Specification | EMS 17N4

PTFE FILLED SPIRAL WOUND GASKETS

Rev: D
By: RJF 2-10-87
Apvd: MFR 2-11-87
Page 1 of 1

FISHER

*Fisher Controls 1987, 1994 Revised By: TDO 6-3-94

1. SCOPE

This specification lists the approved source(s) for spiral wound gaskets constructed from metal windings with PTFE (polytetrafluoroethylene) filler material, their general usage , and product name.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with virgin PTFE used as a filler.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-500 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee, (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, and (3) compliance to load/compression characteristics per Fisher drawings.

6. APPROVED SOURCES

The following material has been approved for all spiral wound gaskets.

(a) Metal windings with PTFE filler
Flexitallic Gasket Company, Inc.
8440 Remington Ave.
Pennsauken, New Jersey 08110
(609) 931-2500

(b) Metal windings with PTFE filler
Flexitallic, Inc.
6915 LaPorte Rd.
Deer Park, TX 77536
(713) 479-3491

(c) Metal windings with PTFE filler
Furon Co.
Metallic Gasket Division
P. O. Box 15639
Houston, Texas 77220
(713) 458-5830

APR 27 1998

MAJOR REVISION
ECRN No. 961398 Date 4-24-97
By HLH Chkd PWD Apvd TDS
840, Old Stock: 1_USE, 2_REWORK, 3_SCRAP/NEW, 4_SCRAP NOW
250, Please: 1_SAFETY, 2_MATL, PQ_IMPROVE, 4_ERROR, 5_STDZN, 6_COST, 7_MKTG/SALES

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Material Specification | CONFIDENTIAL | FMS 17N4

PTFE FILLED SPIRAL WOUND GASKETS

Rev: (A) B
By: RJP 2-16-87
Apvd: NFR 2-18-87
Page 1 of 1

FISHER

*Fisher Controls 1987, 1990 | Revised By: WHH 11-28-90

1. SCOPE

This specification lists the approved source(s) for spiral wound gaskets constructed from metal windings with PTFE (polytetrafluoroethylene) filler material, their general usage, and product name.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with virgin PTFE used as a filler.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-300 AAHR/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee, (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, and (3) compliance to load/compression characteristics per Fisher drawings.

6. APPROVED SOURCES

The following material has been approved for all spiral wound gaskets.

(a) Metal windings with PTFE filler

Flexitallic Gasket Company, Inc.
P. O. Box 489
Dallwyn, NY 08031
(609) 931-2500

6440 Remington Ave.
Pennsauken, N.J. 08110

(b) Metal windings with PTFE filler

Fluorocarbon Furon Co.
Metallic Gasket Division
P. O. Box 15639
Houston, TX 77220
(713) 458-5830

MAJOR REVISION
ECN/N NO. _____ DATE
BY WHH CHK'D RJP APV'D NFR

Update address ( )

FMS4-6

TAYLOR W. 2M COMPANY ET AL

CONFIDENTIAL

Fisher Controls | Material Specification | FMS 17N3

SPIRAL WOUND FLEXIBLE GRAPHITE FILLED GASKETS

Rev: (0)
By: RJF 7-24-86
Apvd: NFR 7-24-86
Page 1 of 1

FISHER

4

*Fisher Controls 1986, 1990

Revised By: MHH 11-20-90

TJG 6-3-91

1. SCOPE

This specification lists the approved source(s) for spiral wound gaskets constructed from metal windings with sheet gasket filler material, their general usage, and product name. The sheet gasket filler cannot contain any form of asbestos.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with flexible graphite used as a filler.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-500 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, and (3) compliance to load/compression characteristics per Fisher drawings.

6. APPROVED SOURCE(S)

The following material has been approved:

(a) Metal windings with Flexicarb™ Filler

Flexitallic Gasket Company, Inc.
8440 Remington Ave.
Pennsauken, New Jersey 08110
(609) 931-2500

MAJOR REVISION JUN 14 1991
ECO/N NO. 940912 DATED 6-3-91
BY TJG CHKD TJG APVD NFR
DISP: 1 USE OLD STOCK
2 SCRAP
3 RETURN
4 SCRAP/RETURN
5 SCRAP WORK
REV REASON: 1 SAFETY, 2 GAGE, 3 IMPROVE, 4 SPECS, 5 ADDED, 6 COST, 7 MATERIAL SOURCE

(b) Metal windings with Grafoil™ Filler

Added new vendor location

Puron Co.
Metallic Gasket Division
P. O. Box 15639
Houston, TX 77220
(713) 458-5830

(b) Flexitallic, Inc.
6915 L. Park, Pd.

Fisher Controls	Material Specification	No. FMS L7N3
FISHER	SPIRAL WOUND FLEXIBLE GRAPHITE FILLED GASKETS	By [illegible] 7-24-96 Appd NFR 7-24-96 Page 1 of 1
©Fisher Controls 1988		Rev

CONFIDENTIAL

1. SCOPE

This specification lists the approved source(s) for spiral wound gaskets constructed from metal windings with sheet-gasket filler material, their general usage, and product name. The sheet gasket filler cannot contain any form of asbestos.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with flexible graphite used as a filler.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-600 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee, (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, and (3) compliance to load/compression characteristics per Fisher drawings.

6. APPROVED SOURCE(S)

The following material has been approved:

(a) Metal windings with ®Flexicarb® ™ Filler

Flexitallic Gasket Company, Inc.
P.O. Box 848
Bellmawr, NJ 08031
(609) 931-2500

FMS4-13/1 (b) Metal windings with Grafoil™ filler

Fluorocarbon
Metallic Gasket Division
P.O. Box 15639
Houston, TX 77220
(713) 458-5830

MAJOR REVISION SEP 26 198

ROA_03838

Fisher Controls | Material Specification | CONFIDENTIAL | FMS 17N2

SPIRAL WOUND COMPOSITION GASKETS

Rev: (C) D
By: RJP 3-27-85
Apvd: NPR 3-27-85
Page 1 of 1

FISHER

*Fisher Controls 1985, 1990

Revised By: MHH 11-20-90
TAG 5-2-94

1. SCOPE

This specification lists the approved source(s) for spiral wound gaskets constructed from metal windings with sheet gasket filler material, their general usage, and product name. The sheet gasket filler cannot contain any form of asbestos.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with chlorite mineral paper with 30% graphite and acrylic binder, or equivalent materials, used as a filler.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-500 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, and (3) compliance to load/compression characteristics per Fisher drawings.

6. APPROVED SOURCE(S)

The following material has been approved:

JUN 14 1994

MAJOR REVISION
ECR/# NO. 94-0917 DATE
BY TAG CHKD JLG APVD NPR
SEQ OLD STOCK SEQ REASON
1 ≤ 90% 1 SAFETY 5 STOCK
2 ELSEWHERE 2 MATL 6 COST
3 SCRAP/REW 3 IMPROVE 7 METRIC
4 GOOD NOW 4 ERROR
EXPLAIN

(a) Metal windings with Flexite™ Super Filler

Flexitallic Gasket Company, Inc.
8440 Remington Ave.
Pennsauken, New Jersey 08110
(609) 931-2500

(b) Metal windings with Verdicarb™ filler

Furon Co.
Metallic Gasket Division
P. O. Box 15639
Houston, Texas 77220
(713) 458-9830

Added new vendor location

(b) Flexitallic, Inc.
[illegible] Rd.

ROA_03839

CONFIDENTIAL

Fisher Controls

FISHER

Material Specification

SPIRAL WOUND COMPOSITION GASKETS

No. FHS 17 N2 (A) B

By R.T. 3/27/85

Appd. NFB 3/27/85

Page 1 of 1

©Fisher Controls 1985, 1988

Rev

1. SCOPE

This specification lists the approved source(s) for spiral wound gaskets constructed from metal windings with sheet gasket filler material, their general usage, and product name. The sheet gasket filler cannot contain any form of asbestos.

2. MATERIAL COMPOSITION

The spiral wound gasket material as covered by this specification shall be metal windings with chlorite mineral paper with 30% graphite and acrylic binder, or equivalent materials, used as a filler.

3. SURFACE RESISTANCE OF MATERIAL

The spiral wound gaskets shall be resistant to sticking to metals such as brass, aluminum and steel. They shall be required to provide an effective seal against surface finishes of 63-600 AARH/RMS.

4. GENERAL USAGE OF SPIRAL WOUND GASKETS

The spiral wound gaskets shall be suitable for general purpose gasket usage in the petroleum, power generation, chemical and general process type industries.

5. QUALITY

The manufacturer of the spiral wound gaskets shall be required to guarantee, (1) material composition, (2) dimensional compliance to appropriate Fisher drawings, and (3) compliance to load/compression characteristics per Fisher drawings.

6. APPROVED SOURCE(S)

The following material has been approved:

(a) Metal windings with Flexite™ Super Filler

Flexitallic Gasket Company, Inc.
P.O. Box 848
Bellmawr, NJ 08031
(609) 931-2500

(b) Metal windings with Verdi Cark™ filler

Fluorocarbon
Metallic Gasket Division
P.O. Box 15639
Houston, Texas 77220
(713) 458-5030

FHS2-36/1

MAJOR REVISION SEP 9 '88

ECR/N NO. _____ DATE

BY NHH CHKD DCB APVD NFB

TAYLOR V. 3M COMPANY ET AL

ROA_03840

FISHER Construction
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

METAL GASKETS

NO. FMS 1761
ISSUED 2/28/73 JWB
REV. PCM 2-8-82
PAGE 1 OF 1

CONFIDENTIAL

1. Scope.

This specification is for soft, annealed sheet or strip for flat metal gaskets and for gaskets made from these materials.

2. Materials

Specification	Max Hardness	Material Ref. Number
Low Carbon Steel	85BHN	2104
AISI Type 302	165BHN	3628
AISI Type 304L	165BHN	3631
AISI Type 304	165BHN	3629
AISI Type 316L	165BHN	3632
AISI Type 316	165BHN	3630
AISI Type 347	165BHN	3633
Hastelloy B	217BHN	4124
Hastelloy C	217BHN	4125
Nickel ASTM B162	120BHN	4127
Alloy 20	180BHN	4126
Cu ASTM B152-110	105BHN	1504
Monel (See FMS 1983)	100BHN	4112
Nickel ASTM B162	120BHN	4142

APR 10 1984

3. Finish

The surface must be 63RMS or better and must be free of nicks and scratches.

4. Gasket Edges

Shearing burrs must be removed.

5. Packaging

Gaskets must be suitably packaged and handled to prevent scratching, bending or other damage.

TAYLOR V. 3 M COMPANY ET AL

ROA_03841

Fisher Controls | Document Cover Sheet | FMS 1ZG44

NITRILE RUBBER O-RING MATERIAL
60-70 DUROMETER A HARDNESS

Rev: D (E)
By: WHH 4-10-91
Apvd: NFR 4-10-91
Page 1

FISHER

©Fisher Controls 1992, 1996 Revised By: TDG 1-15-96

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
1	D (E)						
2	C						
2.1	DELETED A						
3.2	A						
3	C						
4	C						
5	C						

MAJOR REVISION
ECRN No. 96398 Date 11/24/97
By DML Chkd FMD Apvd ZAG
BNO, Old Stock
1 ✓USE
2 _REWORK
3 _SCRAP/NEW
4 _SCRAP NOW
630, Reason
1 _SAFETY
2 _MATL
3 ✓IMPROVE
4 _ERROR
5 _STD/H
6 _COST
7 _MKTG/SALES

MAY 18 1998

Updated to the new electronic format. Any changes to appearance, paragraph numbering, etc., were to accomodate the new document format/style. The appearance of the document will not be the same as before. NO CHANGES TO CONTENT.

Fisher Controls | Document Cover Sheet | FMS 17Q44

NITRILE RUBBER O-RING MATERIAL
60-70 DUROMETER A HARDNESS

Rev: (C) D
By: WHH 4-10-91
Apvd: MFR 4-10-91
Page 1

FISHER

6 1-15-96

*Fisher Controls 1991, 1994

Revised By: TDG (1-10-94)

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
1	(C) D						
2	C						
2.1	Deleted						
2.2	A						
3	C						
4	C						
5	C						

JAN 25 1996

MAJOR REVISION
ECRN No. 160050 Date 11-18-96
By TDG Chkd DRB Apvd
BAO, Old Stock
ISUSE
2_REWORK
3_SCRAP/NEW
4_SCRAP NOW
Explain
BAO, Reason
1_SAFETY
2_MATL
3_IMPROVE
4_ERROR
5_STDZN
6_COST
7_MKTG/SALES

Reason confidential formulation.

TABLE 1
QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (1)
Hardness	FGS 11A1	Shore Durometer A	65±5
Resilience	FGS 11A2	Bashore	30±10
Surface and General Quality	FGS 11A9	—	See Section 4
Fluid Resistance	FGS 11A5		
(a) Hexane 96 hrs. at R.T. + air dry to equilibrium		Volume Swell	+16% max.
		Volume Shrink	-6% max.
(b) Liquid Propane 120 hrs. at R.T. + air dry to equilibrium		Volume Swell	+8% max.
		Volume Shrink	-8% max.

Notes:

(1) All properties measured at RT= 70° ±5°F

[illegible] DOCUMENT REVISION STAMP
[illegible] SEE COVER SHEET
REVISION E TO —

4. BONDING

When bonding of elastomeric parts to metal parts is specified, the following apply:

a) The strength of the adhesive bond must be greater than the elastomer in tension so that when a test sample is destructively tested, the break occurs in the elastomer.

b) The adhesive must be chemically compatible with the elastomer being bonded and resistant to the same classes of chemicals, e.g., hydrocarbons.

c) The adhesive must have the same or better temperature resistance as specified in section 6 of this specification.

d) Any changes in the adhesives or bonding process must be resubmitted to the Materials Research Department of Fisher Controls for testing and re-approval.

e) The vendor must perform quality control testing or process control or both to assure 100% compliance of bonded parts.

5. SURFACE AND GENERAL QUALITY

The finished surfaces of the molded parts shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 10x to 20x magnification. When ground with a suitable grinding wheel the resulting ground surface shall be a smooth, non-porous surface. Molded undercuts such as "snap-on discs" must not have any cracks or tears resulting from stripping the disc from the mold.

DATE 2/-17-94
REVISION STAMP
SEE COVER SHEET
REVISION A TO C

1. SCOPE

1.1 This specification applies to rubber materials to be used primarily as O-rings which will be in contact with commercial Propane and Butane vapors and liquid, natural gas, and all impurities normally contained in these fluids. Molded parts made from materials approved under this specification are used as O-rings in pressure regulators and valves which control the flow of various fluids. The part serves to form a tight shutoff seal. The assembly is normally used in a system where the parts may be subjected to a maximum of 1000 psig gas pressure. The normal service life of the assembly may be as much as 15 years or more without inspection or repair.

1.2 This standard includes references to the following documents:

(a) FGS 11A1, Determination of Durometer Hardness of Rubber and Plastic Materials.

(b) FGS 11A2, Determination of Resilience of Rubber Materials.

(c) FGS 11A3, Determination of Low Temperature Characteristics of Elastomer Materials.

(d) FGS 11A4, Determination of Compression Set Characteristics of Elastomer and Plastic Materials.

(e) FGS 11A5, Determination of Immersion Resistance of Rubber and Plastic Materials.

(f) FGS 11A8, Determination of Tensile Strength Elongation and Heat Aging Resistance of Rubber.

(g) FGS 11A9, Microscope Examination of Elastomers.

2. MATERIAL REFERENCE NO. 0353

3. BASIC MATERIAL

Synthetic rubber molded parts may be required to have manufacturer's identification markings as may be designated on detail drawings or at the end of this specification. Bond strength requirements where rubber is bonded to metal, shall be as noted on the part drawing and/or the inspection specification for the particular part involved.

3.1, 3.2, 4. see revised sheets

MAJOR REVISION DATE 1-13-94
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION 2 TO C

TAYLOR V. 3.M. COMPANY ET AL.

TABLE 2
ADDITIONAL QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria(3)
Tensile Strength	FGS 11A8	PSI	1600 min.
Tensile Elongation	FGS 11A8	%	150 min.
Cold Resistance	FGS 11A3		
(a) Hardness incr. RT to -40°F		Shore Duro	45 Pts. max.
(b) Hardness at -40°F		Shore Duro	89B max.
(c) 180° Bend at -60°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 h.	FGS 11A4 (Type A)	%	2.0% max.
Oven Aging, 7 days, 212°F	FGS 11A8	change in tens. str.	±20% (1)
Anti-Sticking Quality			See Note (2)

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, die cast materials and other metals, when the material is pressed against these metals for long periods of time at loads up to 500 PSI.

(3) All properties except cold resistance measured at 70°±3°F.

change in hardness ±10 pts. max.

7. QUALITY CONTROL TESTING

The tests listed in Table 1 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification. On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

8. PARTS IDENTIFICATION

Unless exception is noted on part drawing, the letter "G-44" shall be printed on a non-critical surface of the part. When parts are too small to allow this, a color dot shall be applied. The identification color for this specification shall be yellow.

Note: If the material specified is the standard for a particular part, then the color code requirement may be waived by Engineering.

9. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

(a) Felmor Laboratories, Inc. AF81-F(5)AC.

MAJOR REVISION DATE 4-30-92
FOR MAJOR REVISION STAMP INFORMATION SEE COVER SHEET
REVISION A TO B

Fisher Controls

Document Cover Sheet
D-RING
NITRILE RUBBER MATERIAL
60-70 DUROMETER A HARDNESS

FMS 17G44
Rev: (A) B
By: WHH 4-10-91
Apvd: NFR 4-10-91
Page 1

FISHER

©Fisher Controls 1991, 1992 Revised By: WHH 4-30-92

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
1	(A) B						
2	(A) B						
3	(A) B						
4	(A) B						
5	(A) B						

JUN 16 1992

MAJOR REVISION
ECR/N NO. _____ DATE 4-30-92
BY WHH CHKD TJG APVD NFR

ADD, OLD STOCK
1 X USE
2 __ REWORK
3 __ SCRAP/NEW
4 __ SCRAP NOW

EXPLAIN

REQ. REASON
1 __ SAFETY
2 X MATL
3 __ IMPROVE
4 __ ERROR

5 X CUSTM
6 __ COST
7 __ MKTG/SALES

Changed heat aging criterion to hardness rather than tensile strength.
Added referenced specifications section

CONFIDENTIAL

Fisher Controls — Material Specification — FMS 17G353

FISHER

HIGH TEMPERATURE FLUOROELASTOMER GASKET MATERIAL (77-87 DURometer "A" HARDNESS)

Rev: B
By: HCA 10-6-66
Apvd: ELD 3-22-76
Page 2

*Fisher Controls — Revised By: TDS 2-15-64

1. SCOPE

1.1 This specification applies to rubber materials to be used as gaskets in contact with air, commercial propane and butane vapors and liquids, natural gases, light oils and all impurities contained in these gases and liquids. Synthetic rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal pressures not in excess of 100 psig. The gaskets are generally used in specialized applications, and the normal service life of the assembly may be as much as 15 years or more without inspection or repair.

1.2 This standard includes references to the following documents:

(a) FCS 1141, Determination of Durometer Hardness of Rubber and Plastic Materials.

(b) FCS 1142, Determination of Resilience of Rubber Materials.

(c) FCS 1143, Determination of Low Temperature Characteristics of Elastomer Materials.

(d) FCS 1144, Determination of Compression Set Characteristics of Elastomer and Plastic Materials.

(e) FCS 1145, Determination of Immersion Resistance of Rubber and Plastic Materials.

(f) FCS 1141, Determination of Tensile Strength Elongation and Heat Aging Resistance of Rubber.

(g) FCS 1149, Microscope Examination of Elastomers.

2. MATERIAL REFERENCE NO. 0420

3. BASIC MATERIAL

Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or at the end of this specification.

3.1 CONTROLS FORMULATION

Ingredients	Parts/Hundred
Viton A-28	100.00
Magnesium D	1.00
N762 Carbon Black	4.00
N990 Carbon Black	30.00
Calcium Calcium Hydroxide	6.00
Viton Curative 20	2.50
Viton Curative 30	4.00
Total	147.50

FISHER

GASKET MATERIAL (77-87 DUROMETER "A" HARDNESS)

Rev: HCA 1 -56
Apvd: ELD 1 -76
Page 2

*Fisher Controls — Revised By: MEH - -92

1. SCOPE

1.1 This specification applies to rubber materials to be used as gaskets in contact with air, with commercial propane and Butane vapors and liquids, with natural gases, and with light oils and all impurities contained in these gases and liquids. Synthetic rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal air (or gas) pressures not in excess of 100 psig. The gaskets are generally used in specialized applications; and the normal service life of the assembly may be as much as 15 years or more without inspection or repair.

1.2 This standard includes references to the following documents:

(a) FCS 1141, Determination of Durometer Hardness of Rubber and Plastic Materials.

(b) FCS 1142, Determination of Resilience of Rubber Materials.

(c) FCS 1143, Determination of Low Temperature Characteristics of Elastomer Materials.

(d) FCS 1144, Determination of Compression Set Characteristics of Elastomer and Plastic Materials.

(e) FCS 1145, Determination of Immersion Resistance of Rubber and Plastic Materials.

(f) FCS 1146, Determination of Tensile Strength Elongation and Heat Aging Resistance of Rubber.

(g) FCS 1149, Microscope Examination of Elastomers.

2. MATERIAL REFERENCE NO. 0420

3. BASIC MATERIAL

Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or at the end of this specification.

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION F TO G

ROA_03850

TAMCO V. 3 M COMPANY ET AL

ROA_03851

CONFIDENTIAL

1. SCOPE

1.1 This specification applies to rubber materials to be used as gaskets in contact with air, commercial propane and butane vapors and liquids, natural gases, light oils and all impurities contained in these gases and liquids. Synthetic rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal pressures not in excess of 100 psig. The gaskets are generally used in specialized applications, and the normal service life of the assembly may be as much as 15 years or more without inspection or repair.

1.2 This standard includes references to the following documents:

(a) FGS 11A1, Determination of Durometer Hardness of Rubber and Plastic Materials.

(b) FGS 11A2, Determination of Resilience of Rubber Materials.

(c) FGS 11A3, Determination of Low Temperature Characteristics of Elastomer Materials.

(d) FGS 11A4, Determination of Compression Set Characteristics of Elastomer and Plastic Materials.

(e) FGS 11A5, Determination of Immersion Resistance of Rubber and Plastic Materials.

(f) FGS 11A8, Determination of Tensile Strength Elongation and Heat Aging Resistance of Rubber.

(g) FGS 11A9, Microscope Examination of Elastomers.

2. MATERIAL REFERENCE NO. 0420

3. BASIC MATERIAL

Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or at the end of this specification.

3.1 COMPOUND FORMULATION

Delete

Ingredient	Parts/Hundred
Viton B-70	100.00
Maglite D	3.00
N762 Carbon Black	4.00
N990 Carbon Black	30.00
Codex Calcium Hydroxide	6.00
Viton Curative 20	2.55
[illegible]	4.00

MAJOR REVISION Date 1-18-96
See Cover Sheet Revision
G to H
for change information

JAN 25 1996

TAYLOR V. 2 M COMPANY ET AL

CONFIDENTIAL

FMS 10E 84

Insert

1.2 This standard includes references to the following documents:

(a) FGS 11A1, Determination of Durometer Hardness of Rubber and Plastic Materials

(b) FGS 11A2, Determination of Resilience of Rubber Materials

(c) FGS 11A3, Determination of Low Temperature Characteristics of Elastomer Materials

(d) FGS 11A4, Determination of Compression Set Characteristics of Elastomer and Plastic Materials

(e) FGS 11A5, Determination of Immersion Resistance of Rubber and Plastic Materials

(f) FGS 11A6, Determination of Tensile Strength, Elongation and Heat Aging Resistance of Rubber

(g) FGS 11A9, Microscope Examination of Elastomers

CONFIDENTIAL

Fisher Controls — Document Cover Sheet — FMS 17033

FISHER

HIGH TEMPERATURE FLUOROELASTOMER
GASKET MATERIAL
(77-87 DUROMETER "A" HARDNESS)

Rev: (E) F
By: KJR 10-6-86
Apvd: (VP) 9-22-76
Page 1 of 6

*Fisher Controls 1983 (1990) 1992

Revised By: WHH (1-9-90)
4-30-92

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
1	(E) F						
2	(E) F						
3	(D) C						
4	(D) C						
5	(A) B						
6	4						

JUN 16 1992

MAJOR REVISION

ECR/N NO. _____ DATE 4-30-92

BY WHH (CHKD TOG APVD DEF

SID PLC SHEET
1 X DSN
2 __ DRAWN
3 __ CHKD/TRCD
4 __ STRESS ANAL

JOB REASON
1 __ SAFETY
2 __ REPL
3 X IMPROVE
4 __ ERROR

5 __ CUST
6 __ MFG/ASSY
7 __ MFG/SALES

Changed to seek to standard ASTM grade.
Added referenced specifications section.

CONFIDENTIAL

*Fisher Controls — Revised by: TMO 1-13-94

3.1 OPEN MIXING PROCEDURE

Mixer Co.

Step	Addition or Procedure
1.	Hand Viton
2.	Add MT30, N907, Maglite D, Cross Blend
3.	Add Viton Curative 20, Viton Curative 30, Calcium Hydroxide, Cross Blend
4.	Sheet Off and Cool

The ingredients listed include tradenames which are desirable to arrive at known properties. The order of mixing is suggested based upon past performance. Any substitution with equivalent materials must be approved by Fisher Controls' materials Research Department.

4. BONDING

When bonding of elastomeric to metal parts is specified, the following apply:

a) The strength of the adhesive bond must be greater than the elastomer in tension so that when a test sample is destructively tested, the break occurs in the elastomer.

b) The adhesive must be chemically compatible with the elastomer being bonded and resistant to the same classes of chemicals, e.g., hydrocarbons and mild chemicals.

c) The adhesive must have the same or better temperature resistance as specified in section 4 of this specification.

d) Any changes in the adhesives or bonding process must be recommended to the Materials Research Department of Fisher Controls for testing and re-approval.

e) The vendor must perform quality control testing or process control or both to ensure 100% compliance of bonded parts.

5. SURFACE AND GENERAL QUALITY

The finished surfaces of the sheet or cut gaskets shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 1X to 20X magnification.

6. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of 0°F to +400°F.

*Fisher Controls — Revised by: MEM 1-[illegible]-94

7. SURFACE AND GENERAL QUALITY

The finished surfaces of the sheet or cut gaskets shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 1X to 20X magnification.

8. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of 0°F to +400°F.

9. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 and 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

10. QUALITY CONTROL TESTING

The tests listed in table 1 shall be considered quality control tests which are to be performed by Fisher Controls or any intending shipment of a production material approved under this specification. On first production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

11. DIMENSIONAL TOLERANCES

The thickness tolerance of the sheet or cut gaskets shall be as follows: (NOTE - Standard thickness for all gaskets under this specification shall be 1/32" unless specified otherwise on the part drawing.)

STANDARD 1/32" thick - 0.031" ± .004"
1/64" thick - 0.047" ± .006"
1/16" thick - 0.062" ± .008"

12. PARTS IDENTIFICATION

Unless exception is noted on part drawing, the designation "N15" shall be printed on a non-critical surface of the part. Some parts are too small to allow this, a color dot shall be applied. The identification color for this specification shall be white.

Note: If the material specified is the standard for a particular part, then the color code requirements may be waived by Fisher Engineering.

MAJOR REVISION DATE [illegible]

ROA_03854

CONFIDENTIAL

Fisher Controls	Material Specification	NO. FMS 17033
FISHER	HIGH TEMPERATURE FLUOROELASTOMER GASKET MATERIAL (77-87 DUROMETER "A" HARDNESS)	By HG-R 10-6-66
		Appd [illegible] 9-22-71
		Page 2 of
©Fisher Controls		Rev W HH 12-12-86

1. SCOPE

This specification applies to rubber materials to be used as gaskets in contact with air, with commercial Propane and Butane vapors and liquids, with natural gases, and with light oils and all impurities contained in these gases and liquids. Synthetic rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal air (or gas) pressures not in excess of 100 psig. The gaskets are generally used in specialized applications, and the normal service life of the assembly may be as much as 15 years or more without inspection or repair.

2. MATERIAL REFERENCE NO. 0420

3. BASIC MATERIAL AND PARTS

Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or at the end of this specification.

4. HARDNESS

82 ± 5 Durometer A at 75° F.

5. RESILIENCE

10^{+10}_{-5} Bashore at 75° F.

6. SURFACE AND GENERAL QUALITY

The finished surfaces of the sheet or cut gaskets shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 18 x to 20 x magnification. (See special note under approved materials - Section 18.)

7. ANTI-STICKING QUALITY

The materials shall be compounded to provide maximum resistance against sticking to brass, steel, die castings, or other metals when the gaskets are compressed against these metals for long periods of time.

JAN 16 1990

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION D TO .

TAYLOR V. 3 M COMPANY ET AL

CONFIDENTIAL

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

FLUOROELASTOMER

HIGH TEMPERATURE GASKET MATERIAL
(77-87 DUROMETER "A" HARDNESS)

NO.	EMS 17033 (C)
BY HGR	10-6-66
APVD ELD	9-22-76
PAGE 2	OF 2
REV KDR	10-26-88

12. Dimensional Tolerances - The thickness tolerance of the sheet or cut gaskets shall be as follows: (NOTE - Standard thickness for all gaskets under this specification shall be 1/32" unless specified otherwise on the part drawing.)

STANDARD 1/32" thick - 0.031" ± .004"
3/64" thick - 0.047" ± .006"
1/16" thick - 0.062" ± .008"

13. Cold Temperature Resistance - Material must not be brittle after 5 hours at -40°F. The hardness increase between 75°F and -40°F shall not be greater than 30 points Durometer A on any given sample.

14. Compression and Recovery - After loading a 1/2" thickness of the material to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 12% of the original.

15. Aging Qualities - The material must have excellent aging qualities. After oven aging for 168 hours at 450°F, the material shall show no visual evidence of cracking or other deterioration and the material hardness shall not have increased by more than 8 points Durometer "A". The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

16. Qualification Testing - Items 3 through 15 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

17. Quality Control - Items 3, 4, 5, 6, 11 and 12 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

18. Approved Materials - The following materials are considered as approved for production use under this specification:

(a) Fairprene
(A) E. I. DuPont VS-0080 (Fluoroelastomer)

(b) Palmer Laboratories
PLV-10096 (1)

MOVE TO NEW PAGE 3

MOVE TO NEW PAGE 4

MAJOR REVISION
ECR/N NO. _____ DATE 7 NFR
BY WHH CHKD DRB APVD
BAD, OLD STOCK
1 _ USE
2 _ REWORK
3 _ SCRAP/RETD
4 _ SCRAP NOW
NO STAMP
1 _ WEIGHT
2 _ MATERIAL
3 _ DRAWING
4 _ SPECIFICATION
5 _ STOCK
6 _ COST
7 _ MINOR SALES

Add new matl's, matl's ref. no.
Add cover sheet & one additional page

ROA_03856

CONFIDENTIAL

*Fisher Controls

Revised By: WHH (1-2-90) 1-30-92

moved to Page 5

TABLE 1
QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurements	Criteria[1]
Hardness	FGS 11A1	Shore "A" Durometer	82±5[2]
Resilience	FGS 11A2	Bashore	10+10 -5
Surface and General Quality	FGS 11A9	—	See Section 4
Fluid Resistance (a) Hexane 4d, RT	FGS 11A5	Volume Swell	+3% max.
+ air dry		Volume Shrink	-3% max.
(b) ASTM #3 (Compressor) Oil 4d, RT		Volume Swell	+3% max.
+ air dry		Volume Shrink	-3% max.

Notes:

[1] All properties measured at 70°±5°F

[2] or 60±5 Durometer "D"

MAJOR REVISION DATE 9-30-92
799 MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION B TO C

CONFIDENTIAL

FISHER Controls
MARSHALLTOWN, IOWA

MATERIAL SPECIFICATION

FMS 17631

HIGH TEMPERATURE GASKET MATERIAL

BY BHK	10-6-66
APVD RLD	9-22-76
PAGE 2	OF 2
REV LMS	9-22-76

1-27-76

12. Dimensional Tolerances - The thickness tolerance of the sheet or cut gaskets shall be as follows: (NOTE - Standard thickness for all gaskets under this specification shall be 1/32" unless specified otherwise on the part drawing.)
STANDARD 1/32" thick - 0.031" ± .004"
3/64" thick - 0.047" ± .006"
1/16" thick - 0.062" ± .008"

13. Cold Temperature Resistance - Material must not be brittle after 5 hours at -40°F. The hardness increase between 75°F and -40°F shall not be greater than 30 points Durometer A on any given sample.

14. Compression and Recovery - After loading a 1/2" thickness of the material to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 12% of the original.

15. Aging Qualities - The material must have excellent aging qualities. After oven aging for 168 hours at 450°F, the material shall show no visual evidence of cracking or other deterioration and the material hardness shall not have increased by more than 8 points Durometer "A". The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

16. Qualification Testing - Items 3 through 15 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

Quality Control - Items 3, 4, 5, 6, 11 and 12 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

Approved Materials - The following materials are considered as approved for production use under this specification.

A. E. I. DuPont ~~VS-6080~~ (Fluoroelastomer)
VS-6080

REJECT NEW DUPONT DESIGNATION & PUBLISHED TENSILE STRENGTH

ROA_03858

Fisher Controls	Material Specification	No. FMS 17833 B
FISHER	HIGH TEMPERATURE FLUOROELASTOMER GASKET MATERIAL (77-87 DUROMETER "A" HARDNESS)	By WHH 12-12-86
		Appd NPR 12-19-86
		Page 4 of
©Fisher Controls		Rev

CONFIDENTIAL

15. AGING QUALITIES

The material must have excellent aging qualities. After oven aging for 168 hours at 450° F. the material shall show no visual evidence of cracking or other deterioration and the material hardness shall not have increased by more than 8 points Durometer "A". The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

16. QUALIFICATION TESTING

Items 3 through 15 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

17. QUALITY CONTROL

Items 3, 4, 5, 6, 11 and 12 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

18. APPROVED MATERIALS

The following materials are considered as approved for production use under this specification.

A. Fairprene VS-0080 (Fluoroelastomer)

B. Palmer Laboratories
PLV-10096 (1)

JAN 16 1990

2 TABLES ADDED

MAJOR REVISION DATE
FOR MAJOR REVISION STAMP
INFORMATION SEE COVERSHEET
REVISION D TO E

CONFIDENTIAL

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17G33 (A)
	HIGH TEMPERATURE GASKET MATERIAL	ISSUED HGR 10-6-66
		REV.
		PAGE 1 OF 1

Fluoroelastomer

Thickness .031" ± .003"

Temperature Range 0 - 400°F

Hardness 80 ± 5 Durometer A

Supplier

DuPont No. 80-080

MAJOR REVISION PRINT
DO NOT REMOVE FROM
ENGINEERING FILES

ENGINEERING DEPT. DATE 2-27-76
MAJOR REVISION
BY LMS CHKD APPD
DISPOSITION OF OLD STOCK USE
SPEC. IS REWRITTEN
ADDED A PAGE

Fisher Controls | Document Cover Sheet | PMS 17G25

NEOPRENE RUBBER GASKET MATERIAL
(50 TO 60 DUROMETER "A" HARDNESS)

Rev: (J) K
By: DA 9-16-88
Apvd: NFR 10-15-85
Page 0.1

FISHER

CONFIDENTIAL

©Fisher Controls 1985, (1990) 1991

Revised By: WEH (11-26-90)
8-23-91

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	(J)K						
1	F						
2	F						
3	(E)F						
4	(D)C						

AUG 29 1991

MAJOR REVISION

ECN/H NO. _____ DATE

BY WHH CHKD ZGS APVD NFR

840. OLD STOCK	850. REASON	
1 _SCRAP	1 _SAFETY	5 _STOLEN
2 _REWORK	2 _HEAT	6 _DUST
3 _SCRAP/REW	3 X IMPROVE	7 _OTHER/ SALES
4 _SCRAP NOW	4 _ERROR	

Add hardness change requirements to oven age test. Also reference to note added.

Fisher Controls | Document Cover Sheet | FMS 17G25

NEOPRENE RUBBER GASKET MATERIAL
(52 TO 60 DUROMETER "A" HARDNESS)

CONFIDENTIAL

Rev: G H
By: DZ 9-15-50
Apvd: NFR 10-15-85
Page 0.1

FISHER

*Fisher Controls 1985, 1989 1990 Revised By: WHH 10-30-90

This page is the cover sheet of all documents containing 3 or more pages of specifications. The table below shows the revision level for each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL	PAGE NUMBER	REVISION LEVEL
0.1	G H						
1	E						
2	E						
3	F D						
4	A						

MAJOR REVISION
ECR/B NO. _____ DATE> SEP 07 1990
BY WHH CHKD DEB APVD NFR

Change dimensial tolerances on 3/4" thick sheet.

Fisher Controls

Document Cover Sheet

CONFIDENTIAL

FISHER

No. FMS 17625

By DZ 9-15-5[illegible]

Appd FR 10-15-5[illegible]

Page 0.1 of

©Fisher Controls 1985, 1989

Rev NRP 11-19-85

Title:

NEOPRENE RUBBER GASKET MATERIAL
(52 TO 60 DUROMETER "A" HARDNESS)

Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level	Page Number	Revision Level
0.1	(E) G						
1	E						
2	E						
3	(B) C						
4	A						
						NOV - 7	1989
				WHH	DRB	NER	
				Changed property requirements to conform to presently used materials.			

This page is the cover sheet of all documents containing 6 or more pages of specifications. The table above shows the revision level of each page of this document. A revision of this page will be made when any page of this document is revised. When referring to this document specify the revision level of this page.

TAYLOR V. 3 M. COMPANY ET AL

Fisher Controls	Material Specification CONFIDENTIAL	No. FMS 37625 E
FISHER	NEOPRENE RUBBER GASKET MATERIAL (52 TO 60 DUROMETER "A" HARDNESS)	By DZ 9-15-68
		Appd NFR 10-14-85
		Page 1 of
©Fisher Controls		By NRP 10-10-85 WHH 11-26-90

1. SCOPE

This specification applies to rubber materials to be used as gaskets in contact with air, with commercial Propane and Butane vapors and liquids, with natural gases, and with light oils and all impurities contained in these gases and liquids. Rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal air (or gas) pressure not in excess of 100 psig. The gaskets are generally used in specialized applications, and the normal service life of the assembly may be as much as 15 years or more without inspection or repair.

2. MATERIALS REFERENCE NOS. - 0408

3. BASIC MATERIAL AND PARTS

Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or in Section 8 of this specification.

4. SURFACE AND GENERAL QUALITY

The finished surfaces of the sheet or cut gaskets shall be smooth and free of imperfections such as cracks, holes, or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross-section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 10x to 20x magnification.

5. SERVICE TEMPERATURE

The material shall not deteriorate and shall function properly in the designated service at temperatures of -40°F to +150°F.

6. QUALIFICATION TESTING

Fisher Controls shall perform the qualification tests listed in Tables 1 & 2 prior to approval under this specification. Following approval, the vendor of such material shall make no changes in the product without notifying Fisher Controls of said changes and the possible need for re-qualification.

DEC 10 1990

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE COVER SHEET
REVISION B TO T

FMS 3-18/1

TAYLOR V. 3 M COMPANY ET AL

CONFIDENTIAL

TABLE 1
QUALITY CONTROL & QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria
Hardness	FGS 11A1	Shore "A" Durometer	55±5
Resilience	FGS 11A2	Bashore	35±10
Basic Material	—	—	See Section 3
Surface and General Quality	FGS 11A9	—	See Section 4
Fluid Resistance (a) Hexane 4d, RT	FGS 11A5	Volume Swell	+27% max.
+ air dry to equilibrium		Volume Shrink	-22% max.
(b) Liquid Propane 5d, RT		Volume Swell	+8% max.
+ air dry to equilibrium		Volume Shrink	-16% max.
(c) ASTM #3 oil 4d, RT		Volume Swell	+6% max.
+ air dry to equilibrium		Volume Shrink	-3% max.
Dimensional Tolerances (2)	—	Inches	1/64" THK-0.035/0.050" 1/16" THK-0.062±0.008" 1/8" THK-0.125±0.020"

Notes:

(1) All properties measured at 70° ±5° F
(2) Unless otherwise specified standard thickness is 1/64"

DEC 10 1990

CONFIDENTIAL

FISHER GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FIS 17625 (D)
	SYNTHETIC RUBBER GASKET MATERIAL	ISSUED DZ 9-15-58
		REV LMB 8-12-76
		PAGE 1 OF 2

1. General - This specification applies to rubber materials to be used as gaskets in contact with air, with commercial Propane and Butane vapors and liquids, with natural gases, and with light oils and all impurities contained in these gases and liquids.

2. Scope of Application(s) - Synthetic rubber parts under this specification are used as gaskets in various types of gas or liquid control instruments. The gaskets may be of several shapes and sizes and will normally be used to seal air (or gas) pressures not in excess of 100 psig. The gaskets are generally used in specialized applications, and the normal service life of the assembly may be as much as 15 years or more without inspection or major repair.

3. Basic Material and Parts - Solid synthetic rubber sheet cut into gaskets of various thicknesses, shapes, and sizes. The sheet or parts may be required to have manufacturer's identification marking as may be designated on detail drawings or at the end of this specification.

4. Hardness - 52 to 60 Durometer A at 75°F.

5. Resilience - 40 ± 10 Bashore at 75°F.

6. Surface and General Quality - The finished surfaces of the sheet or cut gaskets shall be smooth and free of imperfections such as holes or embedments of foreign particles. The material shall contain no flaws, voids, or inclusions and any cross section shall be dense, and free from porosity and other imperfections when a cut edge is viewed under 19 x to 20 x magnification. (See special note under approved materials - Section 18)

7. Anti-Sticking Quality - The material shall be compounded to provide maximum resistance against sticking to brass, steel, die castings, or other metals when the gaskets are compressed against these metals for long periods of time.

8. Service Temperature - The material shall not deteriorate and shall function properly in the designated service at temperatures of -40°F to +160°F.

9. Tensile Strength - Minimum of 1500 psi at 75°F.

10. Elongation - Minimum of 250% at 75°F.

11. Fluid Resistance -

A. Swelling - During immersion for 96 hours at 75°F with dimensional checks being made every 24 hrs., the linear swell in Hexane shall not exceed 12%. After immersion for 120 hrs. at 75°F in liquid Propane, the linear swell shall not exceed 4%. During immersion for 96 hrs. at 75°F with dimensional checks being made every 24 hrs, the linear swell in compressor oil shall not exceed 3%.

B. Shrinkage - The maximum linear shrinkage after removal from the soaking fluids and air dried at 75°F until no further change shall not exceed: Hexane, -7%, liquid Propane, -4%, Compressor Oil, -3%.

UPDATE FORMAT ADD PART DEF. OD. DATE> OCT 30 1985

MAJOR REVISION ECN NO. A2484 DRN KWH CHKD KWH APVD MF

CONFIDENTIAL

FISHER® GOVERNOR CO. MARSHALLTOWN, IOWA USA	MATERIAL SPECIFICATION	NO. FMS 17G25
	SYNTHETIC RUBBER GASKET MATERIAL LMB-8-12-76	ISSUED DZ 9-15-58
		REVISED 5-25-71
		PAGE 2 OF 2

12. Dimensional Tolerances - The thickness tolerance of the sheet or cut gaskets shall be as follows: (NOTE - Standard thickness for all gaskets under this specification shall be 3/64" unless specified otherwise on the part drawing.

1/32" thick - 0.031" ± .004"
STANDARD-3/64" thick - 0.047" ± .006"
1/16" thick - 0.062" ± .008"

13. Cold Temperature Resistance - Material must not be brittle after 5 hours at -50°F. The hardness increase between 75°F and -40°F shall not be greater than 30 points Durometer A on any given sample.

14. Compression and Recovery - After loading a 1/2" thickness of the material to 400 psi at 75°F for 24 hours and allowing it to recover without load for 24 hours, the thickness shall return to within 3.5% of the original.

15. Aging Qualities - The material must have excellent aging qualities. After oven aging for 168 hrs. at 212°F, the material shall show no visual evidence of cracking or other deterioration and the tensile strength shall not have changed by more than 20%. The material shall not be subject to surface cracking or checking under stressed static loading for long periods of time at ambient temperatures.

16. Qualification Testing - Items 3 through 15 as given above shall be considered as qualification tests which will be performed by Fisher Controls prior to approval of any material to be used under this specification. Following qualification approval of a material by Fisher Controls, the vendor of such material shall make no changes in the product without notifying Fisher of said changes and the possible need for re-qualification testing.

17. Quality Control - Items 3, 4, 5, 6, 11, and 12 shall be considered quality control tests which may be performed by Fisher Controls on any incoming shipment of a production material approved under this specification.

On each production batch of an approved material, the vendor shall conduct tests and maintain records of same as he deems necessary to insure that the required quality and properties are maintained. Any production batch of material or parts which fails to meet quality control procedures at Fisher Controls shall be replaced by the vendor.

18. Approved Materials - The following materials are considered as approved for production use under this specification.

A. U.S. Rubber Company M3854 (Neoprene)

B. Garlock, Inc. 8312 (Neoprene) - NOTE: Surface of this material may be satin (fine fabric) finish

MAJOR REVISION PRINT
DO NOT REMOVE FROM
ENGINEERING FILES

ENGINEERING DEPT. DATE 8-27-76
MAJOR REVISION
BY LMB CHKD APPD
DISPOSITION OF OLD STOCK Use

TAYLOR-WINFIELD COMPANY ET AL

ROA_03867

TABLE 2
ADDITIONAL QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FGS 11A8	PSI	1500 min.
Tensile Elongation	FGS 11A8	%	250 min.
Cold Resistance	FGS 11A3		
(a) Hardness incr. RT to -40°F		Shore Duro	30 Pts. max.
(b) Hardness at -40°F		Shore Duro	92A max.
(c) 180° Bend at -60°F, after 5 hrs.		pass/fail)	pass
Compression Set 400 PSI, RT, 24 hrs.	FGS 11A4 (Type A)	%	3.5% max.
Oven Aging, 7 days @ 212°F	FGS 11A8	change in tens. str.	20% (1)
Anti-Sticking Quality	----	----	See note (2) below

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration. Also, the hardness change shall not exceed ± 10 points.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals, when the material is pressed against these metals for long periods of time.

(3) All properties except cold resistance measured at 70° ±5°F.

AUG 28 1991
MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP
INFORMATION SEE ...
REVISION T TO W

CONFIDENTIAL

Fisher Controls — Material Specification — No. FMS 17G25 E

FISHER — NEOPRENE RUBBER GASKET MATERIAL (50 TO 60 DUROMETER "A" HARDNESS)

By NRP 10-10-85
Appd NFR 10-16-85
Page 4 of
Rev WHH 11-24-90

©Fisher Controls

TABLE 2

ADDITIONAL QUALIFICATION TESTS

Property	Test Method	Units of Measurement	Criteria (3)
Tensile Strength	FGS 11A8	PSI	1500 min.
Tensile Elongation	FGS 11A8	%	250 min.
Cold Resistance	FGS 11A3		
(a) Hardness incr. RT to -40°F		Shore Duro	30 Pts. max.
(b) Hardness at -40°F		Shore Duro	82A max.
(c) 180° Bend at -60°F, after 5 hrs.		pass/fail	pass
Compression Set 400 PSI, RT, 24 h.	FGS 11A4 (Type A)	%	3.5% max.
Oven Aging, 7 days, @ 212°F	FGS 11A8	change in tens. str.	20% (1)
Anti-Sticking Quality	---	---	See note (2) below

Notes:

(1) The material shall show no visual evidence of cracking or other deterioration.

(2) The material shall be compounded to provide maximum resistance against sticking to brass, to die cast materials, and to other metals, when the material is pressed against these metals for long periods of time.

(3) All properties except cold resistance measured at 70° ±5°F.

DEC 10 1990

MAJOR REVISION DATE >
FOR MAJOR REVISION STAMP INFORMATION SEE COVER SHEET
REVISION H TO J

731038035 DLJ DLJ V#90520801 0T02 EU76 STK JLR/DBJ/
3 6.00

CC1155 PCC1330 814.00

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER FILE

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. C32108-K2 **EDI**

ORDER DATE
9-03-92

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO
DUKE POWER CO.
OCONEE NUCLEAR STATION C32108-K2
C/O H.A. HEDDEN
HIGHWAY 183

SENECA, SC 29678
UPS BROWN

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI ORDER ********** THIS ORDER HAS BEEN TRANSMITTED ELECTRONICALLY TO THE VENDOR. PLEASE SEND ORIGINAL COPY TO THE EDI COORDINATOR FOR VERIFICATION. **********		
1	1	EA	ASSEMBLY, , RELAY, MFR SPECIFIC INFO: HORIZONTAL MFR: FISHER CONTROLS CO. PART #: AJ6206000A2	115502121	126.00 EA
2	2	EA	GASKET, , TYPE: BELLOWS FRAME MFR: FISHER CONTROLS CO. PART #: 1D396803012	115502602	101.00 EA
3	1	EA		115502586	

(CONT. ON PAGE 2)

SHIPPING TERMS 0001

CASH TERMS NET 30 DAYS

PLAINTIFF'S EXHIBIT 1012.2

PENGAD 800-631-6989

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
Show ID numbers on boxes and invoices if shown on this order.
THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(803) 885-3551
(803) 885-3558

REV. 08/91

		DATE	INVOICE AMOUNT
9/18/92 Acken s/q 2/3 with	T10/20 ltr. S		

731038035 DLJ DLJ V#90520801 0T02 EU76 STK JLR/DBJ/
4 3.00 5 0.30 6 2.00
7 101.00

CC1155 PCC1330

DUKE POWER COMPANY
PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

C32108-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			GASKET, MFR: FISHER CONTROLS CO. PART #: 1N4991-99202		
4	1	EA		115502605	
			ADAPTER, , CONNECTION: MALE MFR: FISHER CONTROLS CO. PART #: 1H784201012		
5	1	EA		115502621	
			ADAPTER, MFR: FISHER CONTROLS CO. PART #: 1H784401012		
6	5	EA		115502555	
			GASKET, , TYPE: SWITCH PLATE MFR: FISHER CONTROLS CO. PART #: 1N8741		
7	4	EA		115500395	

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

***NOTICE TO SELLER**

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
Show ID numbers on boxes and invoices if shown on this order.
THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: _____

File Copy

REV. 08/91

731038035 DLJ DLJ V#90520801 0T02 EU76 STK JLR/DBJ/
8 3.00 9 6.00 10 0.45

CC1155 PCC1330

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. C32108-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			GASKET, , TYPE: RELAY APPLICATION: FOR FISHER 3570 POSITIONER FURNISHED TO DP CO SPEC CNS-1205.06-3 MFR: FISHER CONTROLS CO. PART #: 1H855903012		
8	2	EA		115502617	
			SPRING, MFR: FISHER CONTROLS CO. PART #: 1H8917000A2		
9	9	EA		115000001	
			PIN, , TYPE: TRAVEL MFR: FISHER CONTROLS CO. PART #: 1U909646332		
10	2	EA		115502785	
			GASKET, , SIZE: 1/4" THK, MATERIAL: ASBESTOS APPLICATION: FOR FISHER CONTROL PRESSURE RELIEF VALVE MFR: FISHER CONTROLS CO. (CONT. ON PAGE 4)		

SHIPPING TERMS

CASH TERMS

***NOTICE TO SELLER**

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY PURCHASING DEPARTMENT PO BOX 1002 CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: _____

731077644 ENC ENC V#90520801 OT04 EU76 STK JLR/TLC/
731077432 ENC ENC

CC2444 PCC9370 2541:97

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

FILE

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

3-24-93

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

SHIP TO

DUKE POWER CO.
OCONEE NUCLEAR STATION E14357-K2
C/O H.A. HEDDEN
HIGHWAY 183

SENECA, SC 29678

VIA DELIVER

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI ORDER ********** THIS ORDER HAS BEEN TRANSMITTED ELECTRONICALLY TO THE VENDOR. PLEASE SEND ORIGINAL COPY TO THE EDI COORDINATOR FOR VERIFICATION. **********		
			PLEASE RUSH - ITEMS 1 AND 2 NEEDED FOR UPCOMING OUTAGE.		
1	1	EA	GASKET, , TYPE: BONNET APPLICATION: FOR FISHER GLOBE VALVE MODEL 475-DBQ 2.0 INCH MFR: FISHER GOVERNOR CO. PART #: 1L120899442	244401187	16.45 EA
2	5	EA	O-RING, MFR: FISHER CONTROLS CO. PART #: 1H849806992	254101840	.60 EA
			(CONT. ON PAGE 2)		

PLAINTIFF'S EXHIBIT 1012.3

SHIPPING TERMS FOB: DEST

CASH TERMS NET 30 DAYS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
PO BOX 349
SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(803) 885-3551
(803) 885-3558

FILE COPY

NOTICE TO SELLER

		DATE	INVOICE AMOUNT
6/3/93 Sch to ship wk of 7/8	7/9		

731077644 ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/
731077432 ENC ENC

GG2444 PDC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E14357-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
3	1	EA	ASSEMBLY, , SHAFT AND DISC, TYPE: BUTTERFLY VALVE APPLICATION: BUTTERFLY VALVE 8 INCH TYPE 9110 MFR: FISHER CONTROLS CO. PART #: H11780X0032	254102550	1,493.10 EA
4	2	EA	PACKING, RING, MATERIAL: TEFLON APPLICATION: FOR 24 INCH TYPE 7640 BUTTERFLY VALVE MFR: FISHER CONTROLS CO. PART #: G1860401302	254102508	25.20 EA
5	5	EA	PACKING, , MATERIAL: TEFLON APPLICATION: FOR VEE-BALL VALVE SIZE 6 INCH 657-8-U MFR: FISHER CONTROLS CO. PART #: 1R516001012	254202275	19.53 EA
6	1	EA		254200670	54.81 EA

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY, INVOICE OPERATIONS - PB02G, PO BOX 1015, CHARLOTTE NC 28201-1015
6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO: DUKE POWER COMPANY, OCONEE NUCLEAR STATION, PURCHASING DEPARTMENT, PO BOX 219

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

731077644 ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/
731077432 ENC ENC

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E14357-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			SEAL, , TYPE: BALL APPLICATION: FOR 6 INCH TYPE 657-8-U CONTROL VALVE MFR: FISHER CONTROLS CO. PART #: 1R9703-36142 DWG #: CU5686		
7	1	EA		254200671	308.70 EA
			RING, BACK-UP APPLICATION: FOR FISHER 6 INCH BALL VALVE MFR: FISHER CONTROLS CO. PART #: 1P5698-36042 DWG #: CU5686		
8	2	ST		254600596	25.83 ST
			PACKING SET, APPLICATION: FOR FISHER VALVE 6 INCH TYPE EHT AND SIZE 16 INCH VALVE MFR: FISHER CONTROLS CO. PART #: 1R290801012		
9	3	EA		244400529	44.10 EA
			GASKET, FLANGED FITTING, TYPE: SPIRAL WOUND, MATERIAL: 316 SS WITH ASBESTOS, (CONT. ON PAGE 4)		

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY, INVOICE OPERATIONS - PB02G, PO BOX 1015, CHARLOTTE NC 28201-1015
6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO: DUKE POWER COMPANY, OCONEE NUCLEAR STATION, PURCHASING DEPARTMENT, PO BOX 215, SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

ROA 03877

731077644 ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/
731077432 ENC ENC

CC2444-PC09370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E14357-K2 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			SIZE: 1-13/16" ID X 1-15/16" OD X .175" THK APPLICATION: FOR GLOBE VALVE TYPE DBQ SIZE 1 INCH MFR: FISHER CONTROLS CO. PART #: 1N297999102		
10	2	EA		254101906	166.95 EA
			LINER, , TYPE: VALVE APPLICATION: FOR TYPE 9110 VALVE MFR: FISHER CONTROLS CO. PART #: F2622806782 DWG #: F11733 IT. 197 DELIVERY COMMITMENT: ITEMS 1 & 2 - STOCK PER S. MIRANDA ITEMS 3 & 4 - 2-3 WEEKS (04/15/93) BALANCE - 4-6 WEEKS (05/06/93) NEED DATE: ITEMS 1 & 2 - 03/31/93 BALANCE - ON OR BEFORE 05/30/93 PRICE AND DELIVERY PER PRICE LIST DATED 03/03/93. PRICED BY B. PARKER (CONT. ON PAGE 5)		

SHIPPING TERMS

CASH TERMS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY INVOICE OPERATIONS - PB02G PO BOX 1015 CHARLOTTE NC 28201-1015
6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO: DUKE POWER COMPANY OCONEE NUCLEAR STATION PURCHASING DEPARTMENT PO BOX 219

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

ROA 03878

731077644 ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/
731077432 ENC ENC

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E14357-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			03/22/93.		
			**********		
			* *		
			* CONFIRMATION-DO NOT DUPLICATE (01) *		
			* *		
			**********		
			PURCHASE ORDER NUMBER, ID NUMBER, AND PART(S) NUMBER (AS APPLICABLE) MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PART(S) TAGS, AND INVOICES. (05)		
			SHIPMENTS WILL BE ACCEPTED MONDAY THRU THURSDAY, 8:00 AM TILL 11:30 AM AND 12:30 PM TILL 4:30 PM, EXCEPT HOLIDAYS (INCLUDING EASTER MONDAY, DAY AFTER THANKSGIVING AND CHRISTMAS EVE). IN INSTANCES WHERE SHIPMENTS ARE NOT SO ENDORSED, ALL EXCESS CHARGES FOR DETENT ION OR REDELIVERY WILL BE REBILLED TO TH SUPPLIER. (82)		
			**********		
			* *		
			* PLEASE CONFIRM SHIP DATE UPON *		
			* RECEIPT OF THIS ORDER *		
			(CONT. ON PAGE 6)		

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY, INVOICE OPERATIONS - PB02G, PO BOX 1015, CHARLOTTE NC 28201-1015
6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO: DUKE POWER COMPANY, OCONEE NUCLEAR STATION, PURCHASING DEPARTMENT, PO BOX 219

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

ROA 03879

731077644 ENC ENC V#90520801 0T04 EU76 STK JLR/TLC/
731077432 ENC ENC

GC2444-PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E14357-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			* (4G) *		
			**********		

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY, INVOICE OPERATIONS - PB02G, PO BOX 1015, CHARLOTTE NC 28201-1015
6. ALL OCONEE NUCLEAR STATION PURCHASING DEPARTMENT CORRESPONDENCE IS TO BE MAILED TO: DUKE POWER COMPANY, OCONEE NUCLEAR STATION, PURCHASING DEPARTMENT, PO BOX 419

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

ROA-03880

731087587 ENC ENC V#90520801 0T02 EU76 STK JLR/TLC/

GC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

FILE

18647.30

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E21111-K2 **EDI**

ORDER DATE

5-19-93

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

DUKE POWER CO.
OCONEE NUCLEAR STATION E21111-K2
C/O H.A. HEDDEN
HIGHWAY 183
SENECA, SC 29678
VIA DELIVER

HEREIN DESIGNATED SELLER

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI ORDER ********** THIS ORDER HAS BEEN TRANSMITTED ELECTRONICALLY TO THE VENDOR. PLEASE SEND ORIGINAL COPY TO THE EDI COORDINATOR FOR VERIFICATION. **********		
			ORDER PLACED BY PHONE, BILL PARKER TO S. MERANDA 05/18/93.		
1	1	EA	CAGE, VALVE, VALVE STYLE: GLOBE, VALVE SIZE: 16" APPLICATION: TYPE 476L-16-5-ENA "PISTON" MFR: FISHER CONTROLS CO. PART #: 4U7660X00A2	2444372756	12,070.80 EA
2	10	EA	PACKING, RING, MATERIAL: TEFLON APPLICATION: FOR 24 INCH BUTTERLFY VALVE	254102505	25.20 EA

(CONT. ON PAGE 2)

SHIPPING TERMS: FOB: DESTINATION

CASH TERMS: NET 30 DAYS

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR S... PURCHASING DEPARTMENT CORRESP... CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(803) 885-3551

PLAINTIFF'S EXHIBIT 1012.4

731087587 ENC ENC V#90520801 OT02 EU76 STK JLR/TLC/

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			TYPE 7640 MFR: FISHER CONTROLS CO. PART #: G1860301302		
3	1	EA	CAGE, VALVE, VALVE STYLE: DIAPHRAGM CONTROL, VALVE SIZE: 8" X 10" APPLICATION: FOR 8X10 INCH FISHER DIAPHRAGM CONTROL VALVE MFR: FISHER CONTROLS CO. PART #: 2U228233272	244404368	299.25 EA
4	14	EA	SEAL, , TYPE: SHIM APPLICATION: FOR 16 INCH FISHER V-BALL VALVE,TYPE U MFR: FISHER CONTROLS CO. PART #: 1R23764112	254200730	28.35 EA
5	2	EA	ASSEMBLY, , PLUG STEM, TYPE: GLOBE VALVE APPLICATION: FOR 3 INCH GLOBE VALVE PART NUMBER 11A5229X042 FISHER CONTROL (CONT. ON PAGE 3)	244406939	926.10 EA

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR S... PURCHASING DEPARTMENT CORRESP... CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

ROA 03882

731087587 ENC ENC V#90520801 0T02 EU76 STK JLR/TLC/

GC2444-PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			MFR: FISHER CONTROLS CO. PART #: 11A5229X042		
6	1	EA		254200210	469.35 EA
			SEAL, , TYPE: BALL APPLICATION: FOR FISHER CONTROLS BALL VALVE 16 INCH MFR: FISHER CONTROLS CO. PART #: 1V629805302		
7	6	ST		254201609	51.66 ST
			PACKING SET, APPLICATION: FOR BALL VALVE 16 INCH MFR: FISHER CONTROLS CO. PART #: 1R516201012		
8	6	EA		254202253	9.14 EA
			GASKET, FLANGED FITTING, TYPE: SPIRAL WOUND, MATERIAL: 316 SS WITH ASBESTOS, SIZE: 3-9/16" ID X 4-5/16" OD X .125" THK APPLICATION: FOR FISHER VEE-BALL VALVE U TYPE 10 INCH		

(CONT. ON PAGE 4)

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR S[illegible] PURCHASING DEPARTMENT CORRESP[illegible]CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
P.O. BOX 4000
SENECA, SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: _____

FILE COPY

731087587 ENC ENC V#90520801 OT02 EU76 STK JLR/TLC/

DC2444 PDC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
9	2	EA	MFR: FISHER CONTROLS CO. PART #: 1P927299102 ADAPTER, , TYPE: SEAT RING APPLICATION: FOR A 2 1/2" X 4" X 10" FISHER MODEL ES CONTROL VALVE SERIAL NUMBERS 4831796 & 4831797 MFR: FISHER CONTROLS CO. PART #: 1U2396X0022 DELIVERY COMMITMENT: ITEM 9 - BY 05/20/93 BALANCE - BY 07/01/93(PER S. MIRANDA) PRICE AND DELIVERY PER PRICE LIST DATED 03/03/93. DELIVERY REQUIRED: 7-01-93 PURCHASE ORDER NUMBER, ID NUMBER, AND PART(S) NUMBER (AS APPLICABLE) MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PART(S) TAGS, AND INVOICES. (05) (CONT. ON PAGE 5)	2546320575	1,456.00 EA

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR S[illegible] PURCHASING DEPARTMENT CORRESP[illegible]CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHA[illegible]EPT
PO BOX 219

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

RCA 03684

731087587 ENC ENC V#90520801 0T02 EU76 STK JLR/TLC/

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

E21111-K2 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			"ALL INSIDE PACKAGING AND/OR PACKING MATERIAL MUST BE BIODEGRADABLE, I.E., NO PLASTICS OR STYROFOAM." (2F)		
			"SHIPMENTS WILL BE ACCEPTED MONDAY THRU THURSDAY, 8:00 AM TILL 11:30 AM AND 12:30 PM TILL 4:30 PM, EXCEPT HOLIDAYS (INCLUDING EASTER MONDAY, DAY AFTER THANKSGIVING AND CHRISTMAS EVE). IN INSTANCES WHERE SHIPMENTS ARE NOT SO ENDORSED, ALL EXCESS CHARGES FOR DETENT ION OR REDELIVERY WILL BE REBILLED TO TH SUPPLIER." (82)		
			********** CONFIRMATION-DO NOT DUPLICATE (01) **********		
			********** PLEASE CONFIRM SHIP DATE UPON RECEIPT OF THIS ORDER (4G) **********		

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. TWO COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
INVOICE OPERATIONS - PB02G
PO BOX 1015
CHARLOTTE NC 28201-1015

6. ALL OCONEE NUCLEAR S[illegible] PURCHASING DEPARTMENT CORRESP[illegible]CE IS TO BE MAILED TO:

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
PURCHASING DEPARTMENT
[illegible]
SENECA SC 29679

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

FILE COPY

ROA 03885

363868 OCO REV. 9/92

7310820570 PS JS DHG V#90520801 0T00 CC EU STK EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

5-24-82

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

CNS #001 033-73307

FISHER CONTROLS COMPANY
% ROBERTSE MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

MMIS

SHIP TO: DUKE POWER CO. H23395-73
C/O J. ED SMITH, MGR.
OCONEE NUCLEAR STATION
HIGHWAY 130
P.O. BOX 1439
SENECA, SC 29678

CNS #002

HEREIN DESIGNATED SHIPPER

VIA UPS INSURED

MAKE INVOICE TO: [X] DUKE POWER CO. [ ] MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION, AT THE TIME OR TIMES, AND BY THE MEANS HEREIN SPECIFIED, THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
1	2	EA	DIAPHRAGM,FOR FISHER CONTROLS DIAPHRAGM ACTUATOR MODEL 657 SIZE 45&50 CLASS B FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3 P.O. A-98519	25510087N	54.40 EA
2	2	EA	GASKET,CAGE 3 1/2 X 4 3/32 X 1/32 ASBESTOS SPEC FMS-17A2 P/N-1R384604022 FOR A FISHER 4 IN. GLOBE VALVE	244401862N	1.02 EA
3	2	EA	GASKET,BONNET 5 X 6 3/32 X 1/32 ASBESTOS SPEC.FMS-17A2 PART NO. 1R372404022 FOR A FISHER 4 IN GLOBE VALVE	244401863N	1.53 EA
4	2	EA	PIN,GROOVE TYPE C FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE EC,GS&YD SIZE .75,1,2&3 INCH BODY SCREWED,SOCKET WELD&FLANGED RATING ANSI 600 CLASS B FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3	243900042N	.31 EA
5	2	EA	STEM,PLUG FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ED,ES,ET, EAT&EWT SIZE 2.5,3,4,6,8,6X10,8X10, (CONT. ON PAGE 2)	244400468N	44.20 EA

OK TO FILE NO. H23395-73.001 Fisher Controls Co DATE 6-10-82

SHIPPING TERMS FOB MARSHALLTOWN, IOWA

CASH TERMS NET 30 DAYS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY COMPANY ("BUYER")
W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO: E.A. LAIL

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

(704) [illegible]773

REV. 2/82

FILE COPY

PLAINTIFF'S EXHIBIT 1012.5

7310820570 V#90520801 0T00 CC EU EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SHIPPER

VIA

MAKE INVOICE TO: ... DUKE POWER CO. ... MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER*

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			10X16&14X16 INCH BODY BUTT WELD SCHEDULE 40&80&FLANGED RATING ANSI 600 CLASS F FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3		
6	2	EA	PLUG,VALVE FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ES SIZE 4&6 INCH BODY BUTT WELD SCHEDULE 40&FLANGED CLASS F FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3	244400463N	268.60 EA
7	2	EA	GASKET,SPIRAL WOUND 3 9/16 X 4 1/16 X 0. 175 INCONEL GRAPHITE PART NO. 1R384599442 FOR A FISHER 4 IN GLOBE VALVE	244401864N	18.36 EA
8	2	EA	GASKET,ADAPTOR 5 X 5 15/32 X 1/32 ASBESTOS SPEC. FMS-17A2 PART NO. 1J504704022 FOR A FISHER 4 IN GLOBE VALVE	244401865N	1.53 EA
9	2	EA	RING,SEAT FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ED,ES&ET SIZE 2.5,4&6 INCH BODY BUTT WELD	244400489N	67.32 EA

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

* NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show JD numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

ADDRESS REPLY TO:

(704)

REV. 2/82

FILE COPY

ROA_03887

7310820570 V#90520801 0T00 CC EU EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SHIPPER

VIA

MAKE INVOICE TO: ☐ DUKE POWER CO. ☐ MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER*

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES,

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			SCHEDULE 40&FLANGED DESIGN PRESSURE 380 PSIG DESIGN TEMPERATURE 300 DEGREES F. CLASS C FURNISHED TO D.P.CO. SPEC. CNS-1205.06-3		
10	2	EA	GASKET,SEAT RING 3 1/2 X 3 29/32 X 1/32 ASBESTOS SPEC. FMS-17A2 P/N-1R3B4404022 FOR A FISHER 4 IN GLOBE VALVE	244401866N	.85 EA
11	2	EA	O-RING,7/8 X 1/8 X 1/8 NITRILE PART NUMBER 1B885506992 FOR A FISHER 4 IN GLOBE VALVE	244401867N	.31 EA
12	2	EA	PIN,GROOVE TYPE C FOR FISHER CONTROLS DIAPHRAGM ACTUATED CONTROL VALVE TYPE ES,ET,EWD&U SIZE 2,4,6&8 INCH BODY FLANGED RATING ANSI 300 FURNISHED TO D. P.CO. SPEC. CNS-1205.06-3	243900044N	.31 EA
13	2	EA	O-RING,6 3/4 X 7 X 1/8 NITRILE PART NUMBER 1D547106992 FOR A FISHER 4 IN GLOBE VALVE	244401868N	3.40 EA

(CONT. ON PAGE 4)

SHIPPING TERMS

CASH TERMS

* NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO: _____

(704) _____

REV. 2/82

FILE COPY

7310820570 V#90520801 0T00 CC EU EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SHIPPER

VIA

MAKE INVOICE TO: DUKE POWER CO. / MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER*

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			THIS MATERIAL AND/OR SERVICE SHALL BE FURNISHED UNDER THE QUALITY ASSURANCE PROGRAM OF THE FISHER CONTROLS FACILITY AT GOVERNOR RD. & OLIVE STREET, MARSHALLTOWN, IOWA. PRICE AND DELIVERY PER YOUR QUOTATION DATED 5-17-82. COMMITTED DELIVERY 8-27-82. FORMS ATTACHED: QA-505B 7310820570. DELIVERY REQUIRED: 9-01-82 ID NUMBER AND PURCHASE ORDER NUMBER MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PARTS TAGS, AND INVOICES. (05) THE PROVISIONS OF TITLE 10, CODE OF FEDERAL REGULATIONS, PART 21 APPLY TO THIS PURCHASE. THE SIGNER OF THIS PURCHASE ORDER SHALL BE NOTIFIED IF THIS REGULATION IS INVOKED. (CONT. ON PAGE 5)		SPECIAL CLEANING, PACKAGING, AND DUKE FORM 930.1A - 79.40 EACH. DUKE FINAL INSPECTION IF REQUIRED - 25.00 EACH.

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

ADDRESS REPLY TO:

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

(704)

REV 2/82

FILE COPY

7310820570 CCT HCS AEB V#90520801 0T00 CC EU STK EAL/CDH

PURCHASE ORDER

Mill-Power Supply Co.

IMPORTANT

No. H23395-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SHIPPER

VIA

MAKE INVOICE TO: ☐ DUKE POWER CO. ☐ MILL-POWER SUPPLY CO.
MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER*

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION, AT THE TIME OR TIMES, AND BY THE MEANS HEREIN SPECIFIED, THE FOLLOWING GOODS AND/OR SERVICES

ITEM NO	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			QUALITY ASSURANCE REQUIRED CONTROL LEVEL: 2 PROTECTION LEVEL: B CONDITION LEVEL: #		

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice attach expense bill.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH SHIPPING PAPERS ATTACHED, ARE TO BE MAILED TO:

MILL-POWER SUPPLY CO.
CHARLOTTE, N.C. 28232-2307
P.O. BOX 32307 TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO:

(704)

REV. 2/82

FILE COPY

26050 (R12-81)

PREPARED BY D. S. Miller

DATE 7-23-82

DUKE POWER COMPANY
QUALITY ASSURANCE DEPARTMENT
FORM QA-505B

NUMBER 7310820570

PAGE 1 OF 1

QUALITY ASSURANCE REQUIREMENTS TO BE MET BY VENDORS OF ITEMS AND SERVICES

Items or services on this order must be manufactured or performed under a Duke-approved quality program. In accepting this order the designated vendor commits to the above as well as the performance and documentation of the tests or certifications checked below.

This documentation to be forwarded no later than date of shipment to: Quality Assurance Manager, Technical Services Duke Power Company Post Office Box 33189 Charlotte, North Carolina 28242

Line Item Number From Purchase Order	1. Cert. of Compliance	2. Functional Test	3. Phys. & Chem. Analy.	4. PT	5. MT	6. UT	7. RT	8. Hydro	9.	10.	11.	12. ANSI N45.2.1
1	X											
2	X											
3	X											
4	X											
5	X											
6	X											
7	X											
8	X											
9	X											
10	X											
11	X											
12	X											
13	X											

IMPORTANT NOTICE TO VENDORS:

The documentation specified on this form constitutes an integral part of the purchase order requirements. Failure to supply it as specified will result in the items being quarantined upon receipt.

REMARKS:

*SUPPLY DOCUMENTATION IN ACCORD WITH DUKE SPEC. CNS 1205.06-3 LATEST REVISION.

The following documentation shall be forwarded as indicated above:

X 1. Results of all tests, inspections or certifications checked above.
X 2. Results of all tests, inspections or certifications required by referenced specifications.
X 3. Results of all tests, inspections or certifications required by referenced codes or standards.
X 4. Duke 930.1a Form
____ 5. Duke 930.1c Form
____ 6. ____

NOTIFICATION POINTS:

Vendor shall notify Duke QA Department at telephone number (704)373-4299 5 days prior to the following tests or inspections to allow in plant surveillance by Duke Personnel as deemed necessary.

____ 1. None ____ 2. Hydro Test X 3. Final Inspection
____ 4. NDE: ____
____ 5. Other: ____

PACKAGING AND SHIPPING REQUIREMENTS:

All items to be packaged and shipped per ANSI N45.2.2-1972

Protection B

Rev. 6

Detailed codes, standards and other requirements for tests, inspections or certifications

1.	*
2.	
3.	
4.	
5.	
8.	
9.	
10.	
11.	
12. Clean items per ANSI N45.2.1-1973. Levels specified above.	

FISHER

FISHER SERVICE COMPANY - COLUMBIA, SOUTH CAROLINA

Customer Order Number	Fisher Agent Order Number	Invoice Date	Invoice Number
A06650-77	033 -G04C90985	03/06/91	K022828

Sold To
DUKE POWER COMPANY
P O BOX 1002
CHARLOTTE N.C. 28201

REMIT TO:
FISHER CONTROLS INTL INC
P.O. BOX 459F
ST. LOUIS, MO. 63150

PAGE 2 of 2

Ship To (Same as "Sold To" Unless Otherwise Indicated)
DUKE POWER CO/H B BARRON
OCONEE NUCLEAR STATION
7812 ROCHESTER HWY
SENECA, SC 19679

TERMS:
NET 030 DAYS IN U.S. FUNDS
F.O.B. COLUMBIA, SOUTH CAROLINA

Via UPS NEXT DAY AIR

Date Shipped Mo.	Day	Year
3	5	91

Item No.	Description	Quantity	Unit Price	Net Amount
00010	1P927299102 - GASKET,SPIRAL WOUND TAG: 254202253	3	9.45	28.35
00011	1B885506992 - O-RING TAG: 254202407	13	0.39	5.07
00012	1U222739102 - SEAT RING TAG: 254601358	3	385.00	1155.00
00013	24A1135X012 - SEAT RING TAG: 2546263121	2	770.00	1540.00
00014	38A1025X012 - CAGE,CAVIII,1 STAGE TAG: 2546263124	1	1582.00	1582.00
00015	OVERTIME-CHARGE-/-WEEKEND WORK	1	750.00	750.00
00800	FREIGHT OUT - VIA	1	122.75	122.75
		RATE OK'd S.H.N.	SUBTOTAL	10491.74
			INVOICE TOTAL	10491.74

DUKE POWER RECEIVED MAR 13 1991 INVOICE/ORDER

FISHER MAR 11 1991 MAIL DEPT. PURCHASING

PLAINTIFF'S EXHIBIT 10/2/06

dit will be allowed for material returned without our permission. This material was carefully packed and delivered to the transportation company in good condition. All claims for loss or damage in transit should be made to the transportation any at once. Seller represents that the articles or services covered by this invoice were produced in compliance with the Fair Labor Standards Act of 1938, as amended. If items covered by this invoice are for ultimate export an export e may be required.

Form FG 7165

COPY

7310904483 WA JES V#90520801 0T50 EU76 STK JLR/GGC/P

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

A06650-77 **EDI**

ORDER DATE

SHIP TO

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			* ********** * ********** * PLEASE CONFIRM SHIP DATE UPON * * RECEIPT OF THIS ORDER * * (4G) * **********		

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
2. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
3. Show ID numbers on boxes and invoices if shown on this order.
4. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY PURCHASING DEPARTMENT PO BOX 1002 CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

REV. 09/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336 POWER GROUP (704) 382-2298

FISHER

FISHER SERVICE COMPANY - COLUMBIA, SOUTH CAROLINA

Customer Order Number	Fisher / Agent Order Number	Invoice Date	Invoice Number
A06650-77	033 -G04C93985	03/06/91	K022828

Sold To
DUKE POWER COMPANY
P O BOX 1002
CHARLOTTE N.C. 28201

REMIT TO:
FISHER CONTROLS INTL INC
P.O. BOX 459F
ST. LOUIS, MO. 63150

PAGE 1

Ship To (Same as "Sold To" Unless Otherwise Indicated)
DUKE POWER CO/R B BARRON
OCONEE NUCLEAR STATION
7812 ROCHESTER HWY
SENECA, SC 19679

TERMS:
NET 030 DAYS IN U.S. FUNDS
F.O.B. COLUMBIA, SOUTH CAROLINA

Date Shipped		
Mo.	Day	Year
3	5	91

Via UPS NEXT DAY AIR

Item No.	Description	Quantity	Unit Price	Net Amount
	JOB NO: T15811			
0001	10A4223X012 - SEAL RING/SPR,RADIAL TAG: 244400452	2	80.50	161.00
0002	10A4225X012 - RING,RETAINING,EXT TAG: 244402414	1	25.20	25.20
0003	RPACKX00032 - KIT,REPAIR TAG: 244406359	3	29.40	88.20
0004	11A5229X042 - PLUG/STEM,HI-TEMP TAG: 244406939	2	980.00	1960.00
0005	2BA1010X022 - PLUG/STEM,CAV III TAG: 2444261242	4	661.50	2646.00
0006	1H849806992 - O-RING TAG: 254101840	3	0.39	1.17
0007	G1860301302 - PACKING,V-RING TAG: 254102505	12	26.60	319.20
0008	G1860401302 - PACKING ADAPTOR,MALE TAG: 254102508	2	26.60	53.20
0009	1R516201012 - PACKING,SET TAG: 254201609	1	54.60	54.60

INVOICE CONTINUED

RECEIVED
APR 11 1991
MAIL DEPT.
ORCHARD

dit will be allowed for material returned without our permission. This material was carefully packed and delivered to the transportation company in good condition. All claims for loss or damage in transit should be made to the transportation any at once. Seller represents that the articles or services covered by this invoice were produced in compliance with the Fair Labor Standards Act of 1938, as amended. If items covered by this invoice are for ultimate export an export e may be required.

Form FG 7165

CONFIDENTIAL
ROA_03854

7310904483 WA JES V#90520801 OT50 EU76 STK JLR/GGC/P

CC2444 PCC9370

12424.99

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. A06650-77 **EDI**

ORDER DATE 2-28-91

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO: DUKE POWER CO. A06650-77
C/O H.B. BARRON
OCONEE NUCLEAR STATION
7812 ROCHESTER HIGHWAY
SENECA, S.C. 29678
P.O.BOX 1439, SENECA S.C. 29679

HEREIN DESIGNATED SELLER

VIA YOUR TRUCK

TAX CERTIFICATE NUMBER: NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			********** EDI PARALLEL TEST ORDER ********** THIS ORDER PRINTED FOR VERIFICATION PURPOSES ONLY. ********** PLEASE SEND ORIGINAL TO EDI COORDINATOR. **********		
			ORDER PLACED BY PHONE 2-27-91 B. PARKER TO A. STEHLEY		
1	2	EA	10A4223X012 RING, , TYPE: SPRING LOADED SEAL, APPLICATION: FOR GLOBE VALVE SIZE 4 INCH TYPE ET, 6 INCH TYPE EWT, 6 INCH X 10 INCH TYPE ET, 8 INCH TYPE EWT, 10 INCH X 16 INCH TYPE EWT, 14 INCH X 16 INCH TYPE EWT	2444004	80.50 EA
			MANUFACTURER: FISHER PRODUCTS INC., PART NUMBER: 10A4223X012		
			(CONT. ON PAGE 2)		

MANUAL

SHIPPING TERMS: FOB JOBSITE

CASH TERMS: NET 30 DAYS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY PURCHASING DEPARTMENT PO BOX 1002 CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO: J.L. ROSEMAN

(704) 373-6059

REV. 09/90

TELEX 57-2346 · TELECOPIER: CUSTOMER GROUP (704) 373-3336 POWER GROUP (704) 382-2298

RQA c03895

		DATE	INVOICE AMOUNT
	RIL 3/6 (1) 3/7 l		

7310904483 WA JES V#90520801 0T50 EU76 STK JLR/GGC/P

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

A06650-77 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
2	1	EA	10A4225X012 RING, RETAINING, APPLICATION: FOR GLOBE VALVE SIZE 4 INCH TYPE ET, 6 INCH TYPE EWT, 6 INCH X 10 INCH TYPE ET AND EWT, 10 INCH X 16 INCH TYPE EWT, 14 INCH X 16 INCH TYPE EWT MANUFACTURER: FISHER PRODUCTS INC., PART NUMBER: 10A4225X012	244402414	25.20 EA
3	3	EA	RPACKX00032 KIT, , MODIFIER: REPAIR, TYPE: GLOBE VALVE, APPLICATION: FOR FISHER GLOBE VALVE TYPE 657-AR SIZE 3 INCH DESIGN PRESSURE 300 PSI DESIGN TEMPERATURE 300 DEGREES FAHRENHEIT SOCKET WELD AIR OPERATED CAST STEEL MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: RPACKX00032	244406359	29.40 EA
4	2	EA	11A5229X042 ASSEMBLY, , MODIFIER: PLUG STEM, TYPE: GLOBE VALVE, APPLICATION: FOR 3 INCH (CONT. ON PAGE 3)	244406939	980.00 EA

SHIPPING TERMS

CASH TERMS

NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

REV. 09/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2298

7310904483 WA JES V890520801 OT50 EU76 STK JLR/GGC/P

CC2444 PCC9370

DUKE POWER COMPANY
PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. A06650-77 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			GLOBE VALVE PART NUMBER 11A5229X042 FISHER CONTROL		
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 11A5229X042		
5	4	EA	28A1010X022 STEM, , TYPE: FLOW CONTROL, SIZE: 4", APPLICATION: FOR FISHER VALVE 600 POUND WELD NECK SERIAL NUMBER 8980427	2444261242	661.00 EA
			MANUFACTURER: ROBERT E. MASON CO., PART NUMBER: 28A1010X022		
6	3	EA	1H849806992 O-RING,	254101840	.39 EA
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 1H849806992		
7	12	EA	G1860301302 PACKING, RING, MATERIAL: TEFLON, APPLICATION: FOR 24 INCH BUTTERLFY VALVE TYPE 7640.	254102505	260.60 EA
			(CONT. ON PAGE 4)		

SHIPPING TERMS

CASH TERMS

***NOTICE TO SELLER**

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. *Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.*
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: DUKE POWER COMPANY PURCHASING DEPARTMENT PO BOX 1002 CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

REV. 09/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2298

RDA-03898

7310904483 WA JES V#90520801 OT50 EU76 STK JLR/GGC/P

CC2444 PCC9370

DUKE POWER COMPANY

PURCHASING DEPARTMENT

PURCHASE ORDER

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES. A06650-77 **EDI**

ORDER DATE

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER VIA

TAX CERTIFICATE NUMBER:
NC26 SC1002-19
EIN NUMBER: 56-020550

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: G1860301302		
8	2	EA	G1860401302 PACKING, RING, MATERIAL: TEFLON, APPLICATION: FOR 24 INCH TYPE 7640 BUTTERFLY VALVE	254102508	26.60 EA
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: G1860401302		
9	1	ST	1R516201012 PACKING SET,, APPLICATION: FOR BALL VALVE 16 INCH	254201609	54.60 ST
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 1R516201012		
10	3	EA	1P927299102 GASKET, FLANGED FITTING, TYPE: SPIRAL WOUND, MATERIAL: 316 SS WITH ASBESTOS, SIZE: 3-9/16" ID X 4-5/16" OD X .125" THK, APPLICATION: FOR FISHER VEE-BALL VALVE U TYPE 10 INCH	254202253	9.45 EA
			MANUFACTURER: FISHER CONTROLS CO., PART NUMBER: 1P92729910		

(CONT. ON PAGE 5)

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO:

DUKE POWER COMPANY
PURCHASING DEPARTMENT
PO BOX 1002
CHARLOTTE NC 28201-1002

DUKE POWER COMPANY
PURCHASING DEPARTMENT
R.F. SMITH
General Manager, Purchases

ADDRESS REPLY TO:

REV. 09/90

TELEX 57-2346 TELECOPIER: CUSTOMER GROUP (704) 373-3336
POWER GROUP (704) 382-2298

7310B53281 KK JS MLB V#90520801 0T00 EU76 STK EAL/CJC/C

4

CC1155 PCC1330

IMPORTANT

PURCHASE ORDER

No. M49884-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

MILL-POWER SUPPLY CO.

9-10-85

C02027858

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

HEREIN DESIGNATED SELLER

SHIP TO: DUKE POWER CO. C02027986
C/O M.S. TUCKMAN M49884-73
OCONEE NUCLEAR STATION
HIGHWAY 130
P.O. BOX 1439
SENECA, SC 29679

VIA UPS INSURED

MAKE INVOICE TO: DUKE POWER COMPANY
TAX CERTIFICATE NUMBER
NC 26 SC 1002-19

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*

BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
			MMIS		
			NOTE: SPARE PARTS FOR MODEL NO 621 PRESSURE REGULATOR W/1" PARTS, ON PURGE METER RACK REF ON DWG NO AECC 1192471, EQUIPMENT NO CP-S		
1	4	EA	1A832B000A2 DISC HOLDER, SST FOR MODEL NO 621 PRESSURE REGULATOR WITH 1 INCH PARTS FISHER CONTROL PART NO.1A8328000A2	115502378	4.62 EA
2	4	EA	GASKET, BODY ASBESTOS FOR MODEL NO 621 PRESSURE REGULATOR WITH 1 INCH PARTS ON PURGE METER RACK ON DWG NO AECC 1192471 RADWASTE AEROJET EQUIPMENT FISHER CONTROL PART NO 1A832504032	115500444	.36 EA
3	4	EA	DIAPHRAGM,NITRILE FOR MODEL NO.621 PRESSURE REGULATOR WITH 1 INCH PARTS ON PURGE METER RACK ON DWG NO AEVV 1192471 RADWASTE AEROJET EQUIPMENT FISHER CONTROL PART NO 1E606602052	115502379	1.95 EA
			(CONT. ON PAGE 2)		

SHIPPING TERMS: FOB MARSHALLTOWN, IOWA

CASH TERMS: NET 30 DAYS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: MILL-POWER SUPPLY CO. P.O. BOX 32307 CHARLOTTE, N.C. 28232-2307

MILL-POWER SUPPLY COMPANY ("BUYER")

W.T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO: E.A. LAIL

(704) 5773

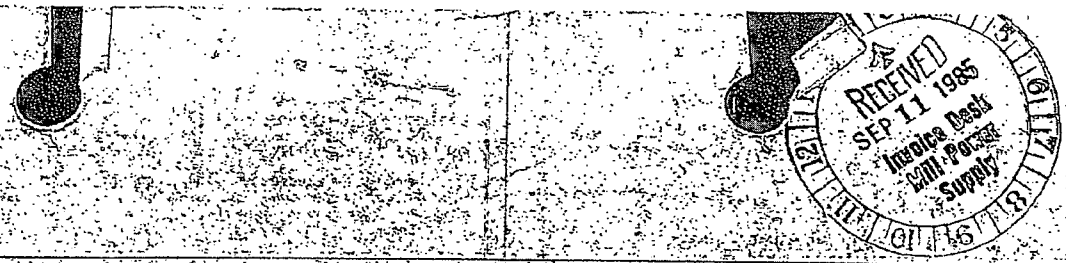
TELEX 5

REV. 9-84

FILE COPY

PLAINTIFF'S EXHIBIT 1012.7

PENGAD 800-631-6989



	DATE	INVOICE AMOUNT
Bkt rec'd 10-21-85 Qtem 1-6	9/	32.05
shipped 10-11-85 Qtem 7 Will	2	84.08
ship by 10-18-85	10/1	
Ack rec'd 10-25-85	10/	
Qtem 6 & 7 S/D 10-7-85	29/	
Mill Power Exp Report rec'd 10-29-85	85	
In Plant 10-18-85 Qtem 6		
shipped 10-11-85 Qtem 7 S/D		
in 10-85		

7310853281 KK JS MLB V$90520801 OT00 EU76 STK EAL/CJC/C

CC1155 PCC1330

PURCHASE ORDER

IMPORTANT

No. M49884-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES.

PAGE 2

MILL-POWER SUPPLY CO.

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER

VIA

MAKE INVOICE TO:

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*
BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	ID NUMBER	PRICE
4	4	EA	O-RING, NITRILE FOR MODEL NO 621 PRESSURE REGULATOR WITH 1 INCH PARTS ON PURGE METER RACK ON DWG NO AECC 1192471 RADWASTE AEROJET EQUIPMENT FISHER CONTROL PART NO 1E472706992	115500515	.36 EA
5	4	EA	1E543520012 GASKET, IRON FOR MODEL NO 621 PRESSURE REGULATOR WITH 1 INCH PARTS ON PURGE METER RACK ON DWG NO AECC 1192471 RADWASTE AEROJET EQUIPMENT FISHER CONTROL PART NO 1E543520012	115502380	.36 EA
6	1	EA	621-141 REGULATOR, PRESSURE 1 INCH SPRING FOR MODEL NO 621 PRESSURE REGULATOR WITH 1 INCH PARTS ON PURGE METER RACK ON DWG NO AECC 1192471 RADWASTE AEROJET EQUIPMENT FISHERCONTROL PART NO 621 20-35 PSIG OUTLET NO 621-141.	115502381	80.64 EA
7	1	EA	621 REGULATOR, PRESSURE 1 INCH SPRING FOR MODEL NO.621 PRESSURE REGULATOR WITH 1 INCH PARTS ON PURGE METER RACK ON DWG NO AECC 1192471 RADWASTE AEROJET EQUIPMENT FISHER CONTROL PART NO.621 25-60 PSIG	115502382	80.64 EA

(CONT. ON PAGE 3)

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: MILL-POWER SUPPLY CO. P.O. BOX 32307 CHARLOTTE, N.C. 28232-2307

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO:

(704)

TELEX

REV. 9-84

FILE COPY

ROA_03902

7310853281 KK JS MLB V890520801 0T00 EU76 STK EAL/CJC/C

CC1155 PCC1330

PURCHASE ORDER

MILL-POWER SUPPLY CO.

IMPORTANT

No. N49804-73

THIS ORDER NUMBER MUST APPEAR ON ALL COPIES OF THE INVOICE AND ON ALL PACKAGES

FISHER CONTROLS COMPANY
% ROBERT E MASON & CO
P O BOX 33424
CHARLOTTE N C 28233

SHIP TO

HEREIN DESIGNATED SELLER

VIA

MAKE INVOICE TO:

MAIL INVOICE AS DIRECTED UNDER NOTICE TO SELLER*
BUYER WHOSE ADDRESS AND SIGNATURE APPEAR BELOW AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER OR TO PERSON HEREIN DESIGNATED AT THE LOCATION AT THE TIME OR TIMES AND BY THE MEANS HEREIN SPECIFIED THE FOLLOWING GOODS AND/OR SERVICES.

ITEM NO.	QUANTITY	UNIT.	DESCRIPTION	ID NUMBER	PRICE
			OUTLET NO. 621-168.		
			DELIVERY COMMITMENT: BY 11-17-85 (10 WKS.)		
			ABOVE ITEMS 1-5 PER R3000X DATED 6/29/85.		
			ITEMS 6&7 PRICE & DELIVERY PER GEORGE CHANG VERBAL QUOTE TO D. LITTLE 9/5/85.		
			DELIVERY REQUIRED: 11-17-85		
			ID NUMBER AND PURCHASE ORDER NUMBER MUST BE SHOWN ON ALL PACKING LISTS, BOXES, CARTONS, REELS, PARTS TAGS, AND INVOICES. (05)		
			THIS PURCHASE IS BEING MADE BY MILL-POWER SUPPLY COMPANY ACTING SOLELY IN ITS CAPACITY AS AGENT FOR DUKE POWER COMPANY.		

SHIPPING TERMS

CASH TERMS

*NOTICE TO SELLER

1. ACKNOWLEDGE ORDER BY PROMPT ACCEPTANCE AND GIVE DATE ORDER WILL BE SHIPPED.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach freight bill or other appropriate shipping documents.
4. Show ID numbers on boxes and invoices if shown on this order.
5. THREE COPIES OF INVOICE, WITH FREIGHT BILL OR OTHER SHIPPING DOCUMENTS ATTACHED, ARE TO BE MAILED TO: MILL-POWER SUPPLY CO. P.O. BOX 32307 CHARLOTTE, N.C. 28232-2307

MILL-POWER SUPPLY COMPANY ("BUYER")

W. T. ROBERTSON, JR., PRES.

ADDRESS REPLY TO:

(704)

TELEX 5

REV. 9-84

FILE COPY

ROA_03903

INACTIVE

Packing To Be Square Braided Blue African Asbestos Impregnated With TFE. And Furnished In Ring Form With Bevel Joint. Packing must be free of excessive graphite and dirt.

The Following Materials Have Been Approved:

Johns-Manville Style No. 2014

Garlock, Inc. No. 5561

INACTIVE

FC_01975

E

© FISHER CONTROLS, 1982

REVISIONS		
DATE	BY	CHKD.
9-15-65	ERB	
6-29-61	JRD	
YL	RRB	

TITLE Blue African Asbestos- TFE Packing

	BY	DATE
DWN.	WP	2-8-56
TRCD.		
CHKD.	HGR	2-17-56
APPR.		
SCALE		

FISHER® GOVERNOR CO.
MARSHALLTOWN, IOWA

DESIGN NO.
DRAWER NO.
SUPERSEDES DWG. NO.

TYPE
SIZE INACTIVE
DWG. NO. EMS17D10
REV. D

ALL DIMENSIONS ARE IN INCHES.

Duimstra 2006-0037