Material Specification	CFP	1000	Revision	B	Date

1.0 **Scope**

1.1 This Commercial Fluid Power specification CFP 1000 covers electric-resistance-welded carbon and alloy steel tubing used for tubes subjected to internal pressure. Material suitable for hydraulic cylinder applications.

1.2 Material will comply with specification ASTM A-513 Type 5 latest revision unless specified otherwise.

1.3 This specifications covers the grades found in ASTM A513 Type 5 and DIN numbers St52.3 and STE460.

2.0 **Referenced Documents**

2.1 All documents referenced in ASTM A513 Type 5 latest revision Section 2.0 latest revision.

3.0 **Ordering Information**

Orders placed by Commercial Fluid Power will contain the following information to adequately describe the desired material:

3.1.1 Quantity

Material may be ordered by total weight, feet or pieces. Allowable over or under shipments of 10% is acceptable. Quantities above or below this 10% is subject to review.

3.1.2 All material ordered under this specification will be designated as resistance-welded carbon or alloy steel mechanical tubing

3.1.3 All material ordered shall be Mandrel Drawn unless specifically requested otherwise.

3.1.4 Thermal description.

Material will be receive one thermal treatment after cold drawing to the finished size. The thermal treatment will be Stress Relief Aneal unless spefically requested otherwise.

3.1.5 All material ordered to CFP-1000 will be No Flash unless specifically requested *otherwise.*

3.1.6 Grade designation.

3.1.7 All material will be ordered to ASTM A513 Type 5 and CFP-1000. Test reports will include reference to ASTM A513 Type 5 and CFP-1000. Chemical properties and Mechanical will be reported. Tensile, Yield, Elongation, **ROA and Hardness.

3.1.8 Material ordered will include machine allowances found in ASTM A513 S1 through S10

3.1.9 CFP-1000 covers only round shapes.

3.1.10 Material ordered will have OD and ID or OD and wall dimensions. Material ordered will placed to a three place decimal for imperial and a two place decimal for metric.

3.1.11 Material ordered will be to one of three options. Length range (17/24), Cut Length (240"C) or an aim length (240" aim Balance 20/27') ***Shorts (See Notes)

- **i** Aim length will compromise a minimum of 90% of the order. Balance of the order will meet a specified length range.

3.1.12 The cut will comply with ASTM A513 section 8.4 for squareness.

3.1.13 Burrs must be removed from the OD and ID from both ends of the tube.

3.1.14 Protective coating

Tubing will be coated with a film of oil before shipping to retard rust. Oil will be easily removed by conventional degreasing methods used prior to plating.

3.1.15 **Packaging**

- **a** 3,000 pound maximum bundles unless specifically requested otherwise.
- **b** Primary bundle configurations to 90% of the load. See Bundle Chart 1.
  - **i** 1, 2, 5, 7, 10, 12, 16, 18, 19, 24, 27 and 29 pieces
- **c** Secondary bundle configurations to 10% maximum. See Bundle Chart 2.
  - **ii** 3, 4, 6, 8, 9, 11, 13, 14, 15 and 17
- **d** Banding
  - **iii** Lengths over 14 feet will have a minimum of 4, 1-1/4" bands.
  - **iv** Lengths under 14 feet will have a minimum of 3, 1-1/4" bands.
- **e** All bundles will have a bundle tag on one end and will contain the following information:
  - **i** Dimensions OD, ID, Length/s
  - **ii** Material Grade
  - **iii** Total footage and Piece Count
  - **iv** Heat Number
  - **v** Commercial Fluid Power PO
  - **vi** Bundle Weight

3.1.16 All material ordered will comply to ASTM A513 Type 5 latest revision and CFP-1000 latest revision.

3.1.19 All material when possible will be continuous stenciled with the following information. If a continuous stencil is not possible stenciling both ends and the middle of the tube is acceptable.

1.0 Dimensions OD, ID or OD and wall
2.0 Material Grade
3.0 Heat Number
4.0 Manufacturers name
5.0 Purchase order number

4.0 Materials and Manufacture

4.1 Steel will be produced by electric arc or one of the basic oxygen processes. Steel shall be fully killed and use clean steel practices.

4.2 Material shall be full body normalized, drawn over mandrel and stress relieved.

4.3 Material shall be stress relief annealed to meet mechanical property requirements. (tensile property and hardness)

4.4 Mechanical tests are to be performed on a representative sample after all thermal and mechanical processes have been completed.

5.0 Chemical Composition

5.1 Steel shall conform to the requirements as to chemical composition prescribed in Tables 1 and 2 of the ASTM A513 specification.

5.2 Steel may be purchased to other material specifications when agreed upon by the producing mill. Standards may include DIN (St52.3) , SAE, ASFOR, JIS or other.

6.0 Heat Analysis

6.1 Heat analysis will conform to ASTM A513 Type 5 specification.

7.0 **Product Analysis**

7.1 Product analysis will conform to ASTM A513 Type 5 specification latest revision. Must be declared at the time of order entry.

8.0 **Permissible Variations in Dimensions for Round Tubing**

8.1 Permissible Variations in Dimensions for Round Tubing will conform to ASTM A513 Type 5 specification latest revision.

8.2 Straightness-Half Commercial straightness. Straightness verification with a 3 foot straight edge and feeler gauge on the OD surface over a 3 foot section of tube.

11.0 **Workmanship, Finish, and Appearance**

11.1 The tubing shall be free of injurious defects and shall have a workmanlike finish.

11.2 The tubing shall be free of scale. In the case of thermally treated tubing a slight amount of color will not be considered cause for rejection.

12.0 **Condition**

No Flash-Tubing further processed for closer tolerances with mandrel tubing produced to outside diameter and wall thickness, inside diameter and wall thickness, or outside diameter and inside diameter to tolerances with no dimensional indication of inside diameter flash.

13.0 **Surface Finish**

13.1 Tubes shall have a surface finish compatible with the conditions (Section 12) to which they are ordered (see Appendix X1).

14.0 **Coating**

14.1 Tubing shall be coated with a film of oil before shipping to retard rust.

15.0 **Rejection**

15.1 Tubes that fail to meet the requirements of this specification shall be set aside and the producer shall be notified

16.0 **Product and Package Marking**

Product marking will conform to CFP-1000 specification section 3.1.15 and section 3.1.19.

16.1 Bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with the Automotive Industry Action Group [AIAG] standard prepared by by the Primary Metals Subcommittee of the AIAG Bar Code Project Team.

17.0 **Packaging/Shipping**

17.1 Will follow bundle size and strapping requirements from CFP-1000 section 3.15.1

17.2 All loads will have horizontal wood blocking. Blocking will be of sufficient thickness to hold the weight of the bundle/s being carried.

17.3 Loads will be delivered on a flat bed trailer suitable for overhead crane unloading.

17.4 Loads are to be strapped using nylon ratchets. NO METAL CHAINS.

17.5 Straps are to be located near blocking to minimize bending.

17.6 All product will be covered with a tarp suitable to protect material from the weather.

17.7 All truck drivers are to call in advance for an unload time.

19.0 **Chemistry**

19.1 Tables 1 and 2 found in ASTM A513 type 5 chemistry for carbon and alloy steels. Chemistry represents heat analysis. Product analysis, except for rimmed or capped steel is to be in accordance with usual practice as shown in Table 3 ASTM A513 Type 5.

19.2 Chemistry requirements for St52.3 and STE460.

	C	**Mn**	**P**	**S**	**Si**
St52.3	.22 Max	1.60 Max	.020 Max	.015 Max	.35 Max
STE460	.18 Max	1.50 Max	.020 Max	.015 Max	.35 Max

20.0 **Diameter Tolerances**

20.1 Tolerances will be in accordance with the table found in ASTM A513 Type 5 table 5.

****Ovality tolerance <3% of the wall (See Notes)

OD Size Range[A]	Wall % of OD	Types 3,4, (Sink Drawn)[A,B] and 5,6, (Mandrel Drawn)[B,C] OD, in.		Types 5 and 6 (Mandrel drawn)[B,C] ID in.	
		over	under	over	under
Up to 0.499	All	0.004	0	…	…
0.500 to 1.699	All	0.005	0	0	0.005
1.700 to 2.099	All	0.006	0	0	0.006
2.100 to 2.499	All	0.007	0	0	0.007
2.500 to 2.899	All	0.008	0	0	0.008
2.900 to 3.299	All	0.009	0	0	0.009
3.300 to 3.699	All	0.01	0	0	0.01
3.700 to 4.099	All	0.011	0	0	0.011
4.100 to 4.499	All	0.012	0	0	0.012
4.500 to 4.899	All	0.013	0	0	0.013
4.900 to 5.299	All	0.014	0	0	0.014
5.300 to 5.549	All	0.015	0	0	0.015
5.550 to 5.999	under 6	0.01	0.01	0.01	0.01

	6 and over	0.009	0.009	0.009	0.009
6.000 to 6.499	under 6	0.013	0.013	0.013	0.013
	6 and over	0.01	0.01	0.01	0.01
6.500 to 6.999	under 6	0.015	0.015	0.015	0.015
	6 and over	0.012	0.012	0.012	0.012
7.000 to 7.499	under 6	0.018	0.018	0.018	0.018
	6 and over	0.013	0.013	0.013	0.013
7.500 to 7.999	under 6	0.02	0.02	0.02	0.02
	6 and over	0.015	0.015	0.015	0.015
8.000 to 8.499	under 6	0.023	0.023	0.023	0.023
	6 and over	0.016	0.016	0.016	0.016
8.500 to 8.999	under 6	0.025	0.025	0.025	0.025
	6 and over	0.017	0.017	0.017	0.017
9.000 to 9.499	under 6	0.028	0.028	0.028	0.028
	6 and over	0.019	0.019	0.019	0.019
9.500 to 9.999	under 6	0.03	0.03	0.03	0.03
	6 and over	0.02	0.02	0.02	0.02
10.000 to 10.999	all	0.034	0.034	0.034	0.034
11.000 to 11.999	all	0.035	0.035	0.035	0.035
12.000 to 12.999	all	0.036	0.036	0.036	0.036
13.000 to 13.999	all	0.037	0.037	0.037	0.037
14.000 to 14.999	all	0.038	0.038	0.038	0.038

21.0 **Wall Thickness Tolerances of Types 5 and 6 (M.D. and S.S.I.D.) Round Tubing**

21.1 All material purchased will conform to Table 7 found in ASTM A513 Type 5.

22.0 **Cut-Length Tolerances for Lathe-Cut Round Tubing**

22.1 Material will conform to Table 10 found in ASTM A513 Type 5.

Outside diameter size, in.[A]	6 in. and under 12 in.	12 in. and under 48 in.	48 in. and under 10 ft	10 ft to 24 ft incl[B]
3/8 to 3 incl	± 1/64 in	± 1/32 in	± 3/64 in	± 1/8 in
Over 3 to 6, incl	± 1/32 in	± 3/64 in	± 1/16 in	± 1/8 in
Over 6 to 9, incl	± 1/16 in	± 1/16 in	± 1/8 in	± 1/8 in
Over 9 to 12, incl	± 3/32 in	± 3/32 in	± 1/8 in	± 1/8 in

22.2 For each additional 10 ft or fraction there of over 24ft, an additional allowance should be made of plus or minus 1/16 in.

23.0 **Tolerance for Squareness of Cut**

23.1 Material will conform to Table 11 found in ASTM A513 Type 5.

	Outside diameter, in.[D]				
Length of tube, ft[C]	Under 1	1 to 2, incl	Over 2 to 3, incl	Over 3 to 4, incl	Over 4
Under 1	0.006	0.008	0.01	0.015	0.02
1 to 3, incl	0.008	0.01	0.015	0.02	0.03
Over 3 to 6, incl	0.01	0.015	0.02	0.025	0.04
Over 6 to 9, incl	0.015	0.02	0.025	0.03	0.04

23.2 Actual squareness normal to length of tube, not parallel to both ends.

23.3 Values given are "go" value of feeler gage. "no go" value is 0.001 in greater in each case

24.0 **Honing Allowance**

24.1 Material will conform to Table S1.1 found in ASTM A513 Type 5.

25.0 **Centerless Grinding Allowance**

25.1 Material will conform to Table S2.1 found in ASTM A513 Type 5.

26.0 **Machine Allowance**

26.1 Material will conform to Table S3.1 found in ASTM A513 Type 5.

27.0 **SSID Tubing Surface Finish**

27.1 Material will conform to Table S4.1 and S4.2 found in ASTM A513 Type 5.
or swipe honed product is acceptable.

28.0 **Hardness Limits and Tensile Properties for Round Tubing**

28.1 Material will conform to Table S5.1 found in ASTM A513 Type 5 except 1020, 1026, St52.3 and STE460. See CFP-1000 Table 1

	Yield Strength ksi (MPa), min	Ulimate Strength ksi (MPa), min	Elongation in 2 in. or 50 mm, %, min	RB min	RB max
Mandrel-Drawn Stress Relieved Tubing					
1008	45(310)	55(379)	12	68	…
1010	45(310)	55(379)	12	68	…
1015	50(345)	60(414)	12	72	…
1021	58(400)	68(469)	10	75	…
1025	60(414)	70(483)	10	77	…
1030	70(483)	80(552)	10	81	…
1035	75(517)	85(586)	10	85	…
1040	75(517)	85(586)	10	85	…
1340	80(552)	90(621)	10	87	…
1524	75(517)	85(586)	10	85	…
4130	80(552)	90(621)	10	87	…
4140	95(655)	105(724)	10	90	…

CFP-1000 Table 1

	Yield Strength ksi (Min/Max)	Ulimate Strength ksi (MPa), min	Elongation in 2 in. or 50 mm, %, min	RB min	RB max
1020	65/90	75	15	75	…
1026	75/95	85	15	80	…
St52.3	75/95	85	18	85	…
STE460	90/110	100	15	92	…

28.2 The aim to Tensile strength will be a minimum of 110% of the yield strength.

28.3 Yield will be determined by 2% offset method.

29.0 **Mill Test Reports**

29.1 The producing mill will provide two (2) material test certificates for each heat provided.

29.2 Test certificates will be representative of the order.

29.3 Test certificates will include reference to CFP-1000 and ASTM A513 Type 5.

29.4 Test certificates will include identification of PO, Mill, Heat No, Buyer (CH/CFP), Date

29.5 Test certificates will include Chemistry, Mechanicals. Yield, Tensile, Elongation, ROA and Hardness

30.0 **Tensile Testing**

30.1 All tensile test will follow the guidelines in accordance to ASTM A370/E8 latest revision.

30.2 Yield tests will be determined by 0.2% offset method

30.3 The Tensile strength will be a minimum of 110% of the yield strength.

31.0 **Hardness**

31.1 Hardness testing will be done in accordance to A370 latest revision.

32.0 **Microstructure**

32.2 The microstructure of St52.3, STE460, 1020 and 1026 will have a ferrite grain size of number 8 or finer.

33.0 **Material Inspection**

33.1 All tubes will undergo non-destructive testing (NDT) systems.*****(See notes)

33.2 Non destructive testing will detect defects equal to 10% of the wall or greater.

33.3 Tubes provided will be free from defects after recommended stock removals.

33.4 Material will be used for pressure vessel applications. Any defect that would be injurious to this application after machine allowances are removed will be cause for rejections.

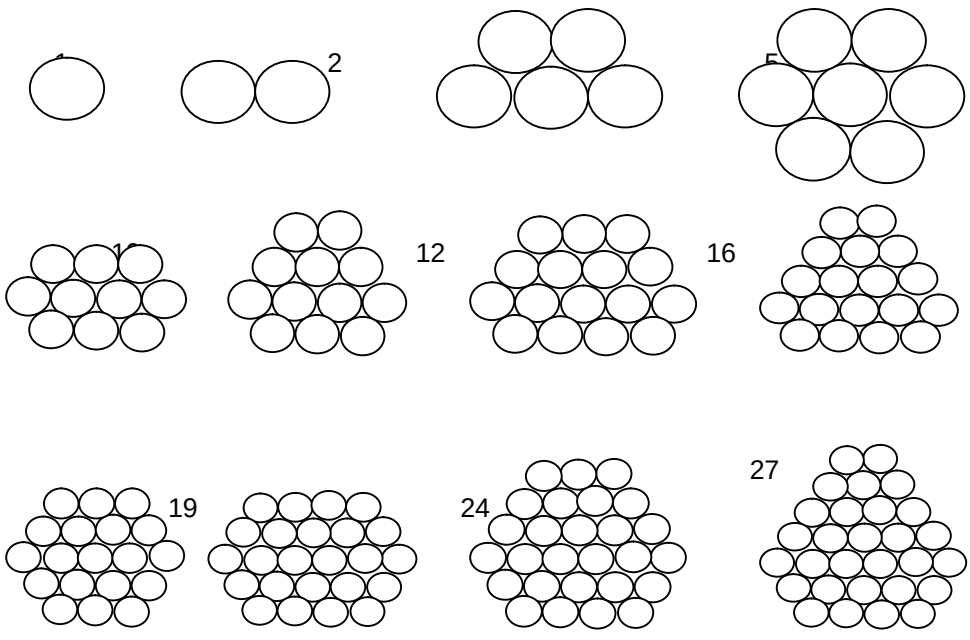
33.5 Defects include but not limited to pits, seams, laps or cracks.

36.0 **Bundling Chart 1 (1,2,5,7,10,12,16,18,19,24,27and 29)**

36.1 90% of mill material will be delivered in one or more of the following bundle configurations.

36.2 Whenever possible use the same bundle quantity for 90% of the load.

36.3 Other bundle configurations are acceptable as long as they are secure, safe and can be stacked safely.

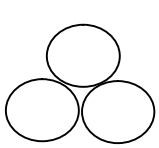


37.0 **Bundling Chart 2 (3,4,6,8,9,11,15,17)**

37.1 Up to 10% of mill material may be delivered in one or more of the following bundle configurations.

37.2 Whenever possible use the same bundle quantity.

37.3 Other bundle configurations are acceptable as long as they are secure, safe and can be stacked safely.



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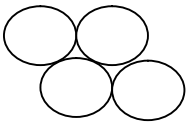

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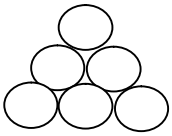

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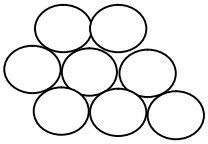

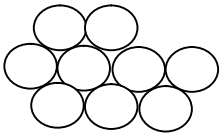

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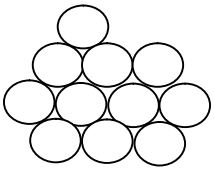

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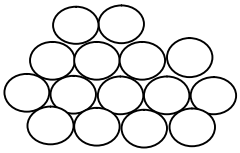

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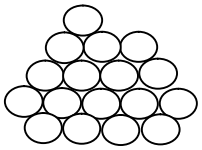

Prepared By: Robert R. Rick
Date: 2/5/2007

Specification: CFP-1000 Revision B

Approved By:

NOTES:

** 3.1.7: Reduction of Area on the tensile test specimen to be reported for informational purposes only.

*** 3.1.11: Commercial Fluid Power will review and advise acceptability of lengths that fall outside of order lengths. Shorts will be bundled separately.

**** 20.1: It should be noted that material with less than 3% of the wall will have an additional ovality tolerance requirement.

***** 33.1 It is the mills option to NDT test material that best suits their production requirements. Accepatble testing includes Eddy Current testing per ASTM E 309 and Flux Leakage testing per ASTM E 570.