A. GENERAL REQUIREMENTS

1. Filler metals and electrodes must meet the requirements of ASME Section II, Part C.

2. Filler metal and electrode manufacturers must be selected from the NOOTER approved manufacturers vendor list (See Attachment A).

3. Procurement of filler metal and electrodes shall be in accordance with ASME Section II, Part C, SFA-5.01. See Attachment B.

4. Levels of testing for all but SFA-5.1 electrodes and SFA-5.18 AWS ER70S-2 filler metals shall be per Schedule I.

5. Lot classifications shall be C3/C4, S3/S4, T3/T4 and F2 depending on the product form.

6. Actual deposited chemistry and typical mechanical values are required for all filler metal and electrodes. See exception in B.I. and B.II.

7. Schedule K testing may be required for special chemistry or mechanical testing requirements etc. Lot classifications shall be the same as defined above.

8. The SFA# and AWS classification and supplemental designators must be marked on the outside of each individual container. The AWS classification and supplemental designators shall be imprinted/stamped/marked on each bare rod/electrode. If flag tagging is used on bare straight length filler metals, they shall be flagged at both ends. AWS classification stamping on the bare straight lengths is preferred over flag tags.

9. All SMAW electrodes must be furnished in hermetically sealed containers. All low hydrogen SMAW electrodes must be furnished in hermetically sealed metal containers suitable for storage in electrode holding ovens.

10. All low hydrogen SMAW electrodes with the designation EXX15, EXX16, or EXX18 must meet H4 diffusible hydrogen requirements. It is preferred that they also meet R requirements for absorbed moisture.

11. All FCAW electrodes for carbon and low alloy materials shall meet H8 diffusible hydrogen requirements.

12. Any weld consumables purchased to the “G” designation will specify on the purchase order the manufacturer name. The consumables will be tested in accordance with Schedule K.

13. Filler material shall be provided in the standard diameters and lengths specified in the applicable ASME SFA specification. The quantity and size ordered will be specified on the purchase order.

14. Certified Material Test Reports (CMTRs) shall be sent with the delivery of materials and approved by the St. Louis or Trevose office.

15. CMTRs are to accompany the billing invoice before payment is made. Material not meeting the requirements in this document may be returned for full refund including any shipping costs and handling by NOOTER.

B. CARBON STEEL FILLER AND ELECTRODE REQUIRMENTS

1. Levels of testing for SFA-5.1 electrodes shall be per Class C3 and Schedule I, reporting typical chemistry and mechanical values.

2. The only E7018 electrode classification acceptable for general use is E7018-1. See Attachment C for history and why E7018-1 is required.

3. Levels of testing for ER70S-2 (SFA-5.18) filler metals shall be per Class S3 and Schedule I, reporting typical chemistry and mechanical values.

4. Schedule K testing may be required for special chemistry or mechanical testing requirements. The special requirements will be defined in the purchase order. Lot classifications shall be the same as defined above for Schedule I.

5. SFA-5.18 ER70S-6 must meet A-No.1 requirements as defined in ASME Section IX QW-442. To meet these requirements the filler material must have a restricted chemistry of 1.40 - 1.60% Mn and 0.80 to 1.00% Si. Actual chemistry and typical mechanical values are required. Chemical determination must be from deposited chemistry.

C. STAINLESS STEEL FILLER AND ELECTRODE REQUIREMENTS

1. All low carbon “L” grade 300 series stainless steel must have a maximum of 0.030% carbon. All “straight” grade 300 series stainless steel must have a minimum of 0.030% carbon content.

2. Ferrite for all 300 series stainless steel except for 310 or 330 must fall within 4 to 9.0% either deposited and measured by instruments or plotted on the Schaeffler diagram, or 4 to 9 FN either deposited and measured by instruments or plotted on the WRC-1992 diagram, using deposited chemistry as reported on Certified Material Test Report (CMTR). 310 and 330 do not have any ferrite requirements. Ferrite content above or below the above stated

values will be rejected. Alternatively, Magna-gage is an acceptable method of determining ferrite content.

3. E/ER16-8-2 shall have ferrite of 1 FN minimum and a maximum of 5 FN. Ferrite content above or below the above stated values will be rejected.

4. Any materials using Bismuth Oxides in 300 S.S. H grade and E/ER16-8-2 coatings or in the solid rod or strip must report Bismuth in actual deposited chemistry and will be rejected if values are greater than 0.002%.

D. CREEP ENHANCED FERRITE STEEL FILLER AND ELECTRODE REQUIREMENTS

1. For Alloy 91 consumables (E9015-B9, E9016-B9, E9018-B9, ER90S-B9, E91T1-B9) the requirements are as follows:

   a. The filler and electrode chemistry shall have a Mn/S ratio of >50, Mn + Ni shall be <1.2%, and Ni/Al ratio > 4.

   b. SMAW and GTAW consumables shall meet an X factor of <15. FCAW wire must meet an X factor of <25. The Bruscato X Factor Formula is X = (10P+5Sb+4Sn+As)*100.

   c. SMAW electrodes shall have a diffusible hydrogen designation of H4. FCAW wire shall have a diffusible hydrogen designation of H8 or lower.

2. All CSEF electrodes shall be supplied with actual chemistry and actual mechanical values per heat/lot as defined in Schedule C3/C4, S3/S4, or T3/T4.

3. When other tests are required to be reported (e.g. impact testing, radiography, fillet test, etc.) the results must be actual. The actual results reported must be for the heat or lot of material tested.

ATTACHMENT A

Approved manufacturers/vendors list for AWS filler metals/electrodes:

Mild Steel	(SFA-5.1)	
E7018-1		Lincoln Excalibur
		Hobart (McKay "Soft-Arc"), ESAB Atom Arc, Bohler [only upon approval by St. Louis WE]
E6010 5P+ or P5		Lincoln
ER70S-2/ER70S-6	(SFA-5.18)	Hobart, Champion, ESAB, Bohler, Metrode, Midalloy, UTP Welding Materials, Washington Alloys, MG Welding Products, Techalloy, MidStates, Lincoln
Low Alloy (any AWS# except "G" designation)	(SFA-5.5 & 5.28)	Hobart, ESAB, Bohler, Metrode, Champion, Techalloy, FilArc, Arcos, Weldwire, Midalloy, Lincoln
Stainless Steels	(SFA-5.4 & 5.9)	Techalloy, ESAB, Hobart (McKay), Bohler, Metrode, Midalloy, Sandvik, Avesta, Arcos, Lincoln
Aluminum	(SFA-5.10)	Midalloy, Weldwire, Harris-Welco, Astrolite, All-State (ESAB), AlcoTec
Nickel and Nickel Alloys	(SFA-5.11/5.14)	Techalloy, Midalloy, Special Metals, Sandvik, Bohler, Metrode, Haynes, Arcos, ESAB, VDM
Steel Flux-cored Wires	(SFA-5.20)	ESAB, Hobart, Kobelco, Midalloy & Lincoln
E71T-8-H16 Gasless Wire		Lincoln
Stainless Steel Flux-cored Wires	(SFA-5.22)	Hobart, ESAB, Midalloy, Metrode, Kobelco, Bohler
Low Alloy Steel Flux-cored Wires	(SFA-5.29)	ESAB, Metrode, Midalloy
E71T8-K6 Gasless Wire		Lincoln
Flux Coated/Cored GTAW Wire (For one sided welding without gas back purge)		All-State (ESAB), Harris, Quality Welding Products

ATTACHMENT B

The following tables are examples of using the forms in SFA-5.01 for ordering welding consumables. Table 1 is for ordering E7018-1. Table 2 is for ordering ER70S-2. See SFA-5.01 for other material forms.

TABLE 1
Covered Electrodes (SFA-5.01 Table A1)

I	General		
	A. Quantity	100 lbs	75 lbs
	B. AWS Specification	A5.1	A5.4
	C. AWS Classification	E7018	E308
	D. Supplemental Designators, if required	-1	L
	E. Diameter	1/8”	3/32”
	F. Length	14	14
	G. Unit Package Type and Weight		
	1. Carton	50 lbs	
	2. Can		10 lbs
	3. Other		
II	Certification and Testing		
	A. Lot Classification	C3	C3
	B. Level of Testing	Schedule I	Schedule I
III	Other Requirements		
		None	Carbon is to be 0.030% maximum. Ferrite is to be between 4 – 9% using the Schaeffler diagram.

(Continuation of ATTACHMENT B)

TABLE 2
Bare Rod (SFA-5.01 Table A2)

I	General		
	A. Quantity	25 lbs	
	B. AWS Specification	A5.18	
	C. AWS Classification	ER70S	
	D. Supplemental Designators, if required	-2	
	E. Diameter	1/16”	
	F. Length (for rods)	36”	
	G. Unit Package Type and Weight		
	1. Spool		
	2. Coil with Support		
	3. Coil without Support		
	4. Rim (reel)		
	5. Drum		
	6. Straight Lengths	10 lbs	
	7. Other		
II	Certification and Testing		
	A. Lot Classification	S3	
	B. Level of Testing	Schedule I	
III	Other Requirements		
		None	

ATTACHMENT C

E7018-1 ELECTRODE SELECTION HISTORY

NOOTER document IN-OP-003 "Nooter Filler Metal / Electrode Requirements" provides the purchase requirements for welding consumables. Attachment A in IN-OP-003 contains the list of approved manufacturers from which to buy E7018-1 electrodes, namely Lincoln Excalibur. It also contains three additional brands, Hobart/McKay, ESAB Atom Arc, and Bohler, that are permitted with specific welding engineering approval. This list is not based on subjective opinion but on a test regimen established by NOOTER, to provide a "one electrode fits all" welding consumable that is most ideally suited for all NOOTER welding applications. Having one electrode brand that meets the bulk of NOOTER customer requirements eliminates the issue of having multiple E7018-1 branded electrodes, each designated for a unique application. Additionally, it prevents the possibility of using a brand of E7018-1 electrode for the wrong project/application.

This test regimen consists of NOOTER personnel welding numerous test plates with the specific brand of E7018-1 electrode to be evaluated, for possible inclusion on the approved manufacturers list. The results of a series of mechanical tests that evaluate the tensile strength, hardness, and toughness are evaluated to determine which electrode is mechanically superior and will consistently deliver desired results. An operator appeal test is also performed where boilermakers and pipefitters weld with each electrode and rank them according to operator appeal. The operator test is a blind test so the welder is not aware of which electrode brand they are welding with.

The results of these tests are compiled in a report written by the welding engineer. The reports are archived and are available for review upon request. Further testing and evaluations of E7018-1 products will continue as consumable manufacturers modify and improve their products. Future evaluations will be based on NOOTER mechanical property requirements in order to bring our customers the best products, and also will be graded on operator appeal in order to deliver an acceptable consumable to the welders employed by NOOTER.