MEL98-001-OQ

SPECIFICATION

UNIVERSITY OF CALIFORNIA

LAWRENCE LIVERMORE NATIONAL LABORATORY

MECHANICAL ENGINEERING, LIVERMORE

Title:	Author:	Date:
Fabrication of NIF Laser Components and Structures	William Gourdin	May 11, 2016
	Technical Reviewer:	**Date:**
	William Gourdin	May 11, 2016
NIF0118304-AE	**Production Reviewer:**	**Date:**
	William Gourdin	May 11, 2016
	Approver:	**Date:**
	William Gourdin	May 11, 2016

1. SCOPE

1.1. This specification defines fabrication protocols, fabrication restrictions, permitted cutting fluids, permitted tapping fluids, permitted abrasives, and precautions for ensuring materials and

components designated for use in the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) may be cleaned to NIF-required levels. This document, by itself, does not generally provide all fabrication requirements.

2. REFERENCED DOCUMENTS

- MEL98-028 – *Procedure to Qualify Cutting Fluids*, NIF5002866
- MEL03-009 – *Approved Cleanliness Materials,* NIF5012898
- MEL99-009 – *Gross Cleaning of NIF Components and Structures*, NIF5004297
- MIL-STD-130 *Identification Marking of U.S. Military Property*

3. FABRICATION REQUIREMENTS

3.1. *Machining*: The Seller shall ensure that no machining operations which might result in contaminants becoming embedded in the material surface are performed. Contaminants, as referred to in this specification, include all foreign materials that are not part of the basic composition of materials specified on the drawings. Examples of contaminants include, but are not limited to, oil, dirt, petroleum based lubricants, metal or other chips, sand, glass, non-water-soluble cutting fluids, and any compound containing sulfur.

3.1.1. *Metal Cutting*: The Seller is permitted to use plasma-arc cutting of metals for the purposes of cutting material to size prior to machining operations. Sufficient material allowance shall be made for complete removal of the Heat Affected Zone (HAZ) during subsequent machining processes. The Seller shall perform a subsequent machining process to eliminate all cracks or fissures which may have occurred during the thermal cutting operation. The HAZ shall be completely removed by machining only, and shall bring the part to a clean bright metal finish.

3.2. *Blasting*: Because particles may become embedded in surfaces and thereby create a source of contamination, bead or abrasive blasting is not permitted on any surface which will not receive further material-removal or finishing steps unless otherwise approved in writing by the University or

unless specified in contract documents. Bead or abrasive blasting is permitted prior to further material removal or finishing if needed to remove mill scale[1] or other surface defects.

NOTE: Where the University desires an optically dispersive surface, the University may spcifiy one of the following treatments:

a) Glass bead blasting with new clean glass beads, or

b) For austenitic stainless steel only: Gross cleaning in accordance with MEL99-009, treatments G-I or G-II followed by immersion for 3 hours in an etching solution containing 40 vol% of 70 wt% HNO_3 (Nitric Acid) and 5 vol% of 50 wt% HF (Hydrofluoric Acid) in deionized water heated to 100° -110° F. Remove from solution and thoroughly rinse with deionized water. Ensure adequate rinsing with pH paper. Repeat gross cleaning in accordance with MEL99-009, treatments G-I or G-II.

c) For austenitic stainless steel only: Gross cleaning in accordance with MEL99-009, treatments G-I or G-II followed by immersion for 10-30 minutes in an etching solution containing 15-20 vol% of 98wt% sulfuric acid in de-ionized water at 25C (77°F) at a current density of 5A/ft^2 until the surface has a matte finish. Remove from solution and thoroughly rinse with de-ionized water. Measure pH of rinse water with pH paper to ensure adequate rinsing. Repeat gross cleaning in accordance with MEL99-009, treatments G-I or G-II.

3.3. *Abrasives:* The Seller shall ensure that no free abrasives (including free-abrasive grinding, blasting or honing) or polishing compounds are used unless approved in writing by the University. Fixed abrasives may be used but shall be limited to aluminum oxide, aluminum silicate, silicon carbide, and diamond unless otherwise approved in writing by the University. ScotchBrite™ abrasive ("scuff") pads approved for use on NIF components are listed in MEL03-009.

NOTE: ScotchBrite™ abrasive pads shall be specified by product number and abrasive type, as indicated in MEL03-009, *not* by color. Only approved ScotchBrite™ pads shall be used on NIF components.

[1] A heavy oxide layer that may form during the hot fabrication or heat treatment of metals. Mill scale is often associated with discoloration of metal surfaces.

NOTE: Ferric oxide (jeweler's rouge) is known to be a particularly problematic contaminant for the NIF project; hence, the University will not approve its use as an abrasive.

3.4. *Grinding:* The Seller may perform block or wheel grinding where the abrasive used is permitted under section 3.3, and the grinding blocks/wheels are controlled such that each grinding block/wheel that is used on mild steel is not also used on stainless steel or aluminum.

3.5. *Brushes:* The Seller shall ensure that only brushes with stainless steel bristles shall be used for cleaning stainless steel or aluminum.

3.6. *Tools:* The Seller shall ensure that tools are cleaned of all foreign material, except for approved cutting fluids prior to use on NIF components. Tools previously used on mild steel shall not be used on stainless steel or aluminum. Tools include wire brushes, files, burrs, chisels, forming dies, and cutting tools.

3.7. *Deburring:* The use of a file or deburring knife is acceptable (ref: section 3.6). Deburring by abrasive vibrating or tumbling is permitted only if the medium is aluminum oxide or silicon carbide in conjunction with approved fluids as specified in Section 3.12. The Seller shall not use other deburring methods without prior written permission from the University.

3.8. *Surface Finishes*: The Seller shall treat all surfaces as required to assure that they will not interfere with subsequent cleaning processes.

3.8.1 All weld splatters, slag, Mill Scale[1], discolorations, inclusions, dark markings, dark stains, and carbonization shall be removed by machining, abrading, blasting or grinding as specified in this document.

3.8.2 For aluminum, in addition to the above, all Mill Finish[2] surfaces shall be removed by machining, abrading, blasting or grinding as specified in this document

3.8.3 Except where required by function or contract documents, surfaces shall not grab or snag an approved Cleanroom Wiper (see MEL03-009).

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[2] Mill Finish is a nonstandard and often non-uniform surface finish left on mill products after final working, forming or heat-treating. Mill Finish surfaces on aluminum may consist of thick oxide layers or baked-on lubricants that will stain when cleaned, even though the surface is free of visible defects.

3.9. *Machined Surfaces:* Machined surface finishes shall be 1.6 μm (63 μin) or smoother or as specified on the drawings.

3.10. *Sealing Surfaces:* All "sealing surfaces" shall be maintained free of dirt, grit, dust, and any other contaminants that could prevent a good seal. Sealing surfaces shall be protected during handling and subsequent operations including packaging and shipping to prevent contamination, scoring or other damage. Sealing surfaces are indicated on drawings.

3.11. *Polishing:* If the surface finish requirements cannot be met by machining alone, then the Seller is permitted to polish with approved abrasives named in Section 3.3. Burnishing or discoloration due to heating from excessive rubbing and or contact pressure shall be avoided.

3.12. *Permitted Cutting, Tapping & Fabrication Fluids:* The Seller shall ensure that cutting or tapping fluids, machining lubricants, hydraulic fluids, wetting agents, etc. for use in machining or polishing shall be limited to those specifically approved by the University.

3.12.1 An up-to-date listing of approved cutting fluids may be obtained from the NIF Approved Materials Database (http:/materials.llnl.gov)by using the keywords "cutting fluid."

3.12.2 The following fluids have been approved for general use on NIF external to the laser amplifiers (these fluids have been tested for chemical cleanliness after gross and precision cleaning as described in MEL98-028):

- Accu-Lube™ LB-2000[3]
- Alumicut™[4]5
- Blaser[5] – Blasocut 2000 CF, Art. 875
- Blaser – Blasocut 2000SW, Art. 870SW
- Blaser – Blasocut 2000 Universal, Art. 870
- Blaser – Blasocut 4000 Strong, Art. 872

[3] ITW Rocol North America, 3650 West Lake Avenue, Glenview, Illinois 60026, telephone 800-452-5823 ext. 2 or 847-657-5278.

[4] Mistic Metal Mover, Incorporated, 1160 N 6th Street, Princeton, IL 61356-9564, telephone (815) 875-1371.

[5] Blaser Swisslube, 31 Hatfield Lane, Goshen, New York 10924, 845-294-3200, fax 845-294-3102, http://www.blaser.com

- Blaser – Blasocut™ BC 20, Art. 1200-05 (aluminum only)
- Blaser – Blasocut BC35SW, Art. 40020
- Blaser[6] – Blasocut Kombi, Art. 883
- Blaser – Blasomill CSF 22
- Blaser B-Cool 755
- Blue Chip[7] – Permasol B
- Bosse Lubricants[8] – Bos-Syn 210
- Castrol[9] – Syntilo 9913
- Castrol – Wy4-876A
- Castrol – Clearedge 6519
- Castrol - HYSOL MB50™
- Milacron[10] – CIMSTAR 40 F
- Milacron – CIMSTAR 60 LF
- Milacron – CIMTECH 410
- D.A. Stuart[11] – Dascool 2227
- D.A. Stuart – Dascool 2227B
- D.A. Stuart – Dascool 780
- Fuchs[12] – Ecocool SYN 005ND

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[6] Blaser Swisslube – Blasocut Kombi, Art. 883 is identical to the now discontinued product Blasocut 4000 CF, Art. 877. This is based on a letter from the President of Blaser Swisslube dated June 5, 2001. Blaser Swisslube still manufactures Blaser 4000 Strong, Art. 872 as a separate product distinctly different from Blasocut 4000 CF, Art. 877

[7] Blue Chip Metalworking Fluids, Inc, 8889 Hague Road, Indianapolis, IN 46256, 317-594-1182, fax 317-594-1185

[8] Bosse Lubricants, 1300 E. Gibson Lane, Phoenix, AZ 85034, 800-367-9966 [exclusive product of Star Metal Fluids, 1300 E. Gibson Lane, Phoenix, AZ 85034; 602-256-2092]

[9] Castrol Industrial North America, Inc., 150 West Warrenville Road, 605 3E, Naperville, Illinois 60563, 877-641-1600 fax 877-648-9801, www.castrol.com/industrial

[10] Milacron Marketing Company, 3000 Disney Street, Cincinnati OH, 45209; 888-246-2665, fax 800-205-3293, www.cimcool.com

[11] D.A. Stuart Company, 4580 Weaver Parkway, Warrenville, IL 60555, 630-393-0833, fax 630-393-0834, www.dastuart.com

[12] Fuchs Lubricants Co. 17050 Lathrop Ave. Harvey, IL 60426, 708-333-8900, www.fuchs.com

- Fuchs – Ecocool AP 71
- G-C[13] – Aqua Syn 55
- G-C – Aqua Kool 21EP-5
- G-C – Aqua Kool 21 EP-7ND (Non-Dyed)
- Hangsterfer's[14] – S-500 CF
- Hangsterfer's – S-506 CF
- Hangsterfer's – S-500
- Hangsterfer's – S-502
- Hangsterfer's Hard Cut 5518
- Houghton[15] – Hocut 795-KB
- HYSOL MB50™[16]
- Kool Mist Formula 77
- ITW[17] – Safe Tap Plus
- ITW – Runstlick WS-5050
- Master Chemical[18] – Trim E206
- Master Chemical – Trim C275
- Metalloid Corp.[19] – Metsol 675
- Mobil[20] - DTE Excel 46

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[13] G-C Lubricants Co., 977 Bransten Road, San Carlos, CA 94070, 650-592-1050, www.gclube.com

[14] Hangsterfer's Laboratories Inc., 175 Ogden Road, Mantua, NJ 08051, 856-468-0216, fax 856-468-0200, www.hangsterfers.com

[15] Houghton International, Inc., P.O. Box 930, Valley Forge, PA 19482, 610-666-4000, fax 610-666-1376, www.houghtonintl.com

[16] Castrol Industrial North America, Inc., 150 West Warrenville Road, 605 3E, Naperville, Illinois 60563, 877-641-1600 fax 877-648-9801, www.castrol.com/industrial

[17] ITW ROCOL North America, 3624 West Lake Avenue, Glenview, IL 60025, 800-452-5823, fax 800-952-5823, www.rocolnorthamerica.com

[18] Master Chemical Corp. 501 W. Boundary, Perrysburg, OH 43551-1263, 800-537-3365, fax 419-874-0684, www.masterchemical.com

[19]Metalloid Corporation, 500 Jackson Street, Huntington, IN 46750, www.metalloidcorp.com

[20] Exxon Mobil Corporation, 3225 Gallows Road, Fairfax, VA 22037, 1-800-Mobil25 (662-4525), www.mobil.com

- Oemeta[21] Hycut™ CF 21 mixed with Oemeta Additiv™ BF 1 :1
- Oemeta Novamet® 900
- QualiChem[22] Q-Cut 245C™
- QualiChem[23] Xtreme Cut™ 250
- Relton[24] – A-9
- Safe Tap Plus™[25]
- Shell[26] – Adrana Coolant 780
- Spartan[27] – Sparcut NC
- Spartan – Synspar GP
- Trico[28] – Tricool TC-1
- Valenite[29] – Valcool VNT 800
- Valenite – Valcool VNT 935
- Vulcan[30] – Cutrite 2200
- Vulcan – Orion Synthetic 7397-2
- Vulcan – Ultrasol 2000EP
- Vulcan – Ultrasol 5720

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[21] Oemeta Incorporated, 2125 Center Avenue, Suite 507, Fort Lee, NJ, Telephone: 201-720-2829, FAX: 201-302-6062

[22] Qualichem, Inc., P.O. Box 926, Salem,VA 24153, Telephone 540-375-6700, FAX 540-375-3880

[23] Qualichem, Inc., P.O. Box 926, Salem,VA 24153, Telephone 540-375-6700, FAX 540-375-3880

[24] Relton Corporation, 317 Rolyn Place, Arcadia, CA 91007-2838, 800-423-1505, www.relton.com

[25] ITW Fluid Products Group, 3624 West Lake Ave, Glenview IL 60025, Tel 800-452-5823 Fax 800-952-5823, www.rocolnorthamerica.com

[26] Shell Oil Company, 800-782-7852, www.shell-lubricants.com

[27] Spartan Chemical Company, 1110 Spartan Drive, Maumee. OH 43537, 800-537-8990, www.spartanchemical.com

[28] Trico Manufacturing Corporation, 1235 Hickory Street, Pewaukee, WI 53072, 800-558-7008, fax 262-691-2576, www.tricomfg.com

[29] Valenite LLC, 1675 East Whitcomb Street, Madison Heights, MI 48071-4628, 800-488-9073, www.valenite.com

[30] Vulcan Oil & Chemical Products, 5353 Spring Grove Ave. Cincinnati, OH 45217, 800-535-3885, fax 513-242-4488, www.vulcanoil.com

- Wallover[31] – WS-6500
- Wallover – WS-8065
- Water - deionized or distilled
- Wisco[32] – 4776
- Xtreme Cut 250™[33]

3.12.3 The fluids in Table 1 have been further tested by exposure to flash lamp light according to MEL98-028 and are the only ones approved for use on components of the laser amplifiers.

Table 1 Specific cutting fluids approved for specific materials in the laser amplifiers

Cutting Fluid	Stainless Steel	Aluminum
Blaser – Blasocut Kombi, Art. 883	Approved	Approved
Blaser – Blasocut BC35SW	Approved	Approved
Blue Chip – Permasol B	Approved	Approved
Castrol – Syntilo 9913	Approved	Approved
Castrol – Wy4-876A	Approved	Approved
Milacron – CIMSTAR 40 F	Approved	Approved
D.A. Stuart – Dascool 2227	Approved	Approved
D.A. Stuart – Dascool 2227B	Approved	Approved
Hangsterfer's – S-500 CF	Approved	Approved
Vulcan – Cutrite 2200	Approved	Approved
Vulcan – Orion Synthetic 7397-2	Approved	Approved
Vulcan – Ultrasol 5720	Approved	Approved

[31] Wallover Oil Company, 21845 Drake Road, Strongsville, OH 44149, 800-255-9626, fax 440-238-0395, www.wallovermwf.com

[32] Wisco, P.O. Box 20893, Indianapolis, IN 46220; 317-784-4689

[33] Qualichem, Inc., P.O. Box 926, Salem,VA 24153, Telephone 540-375-6700, FAX 540-375-3880

3.12.4 Use of all other cutting fluids, tapping fluids, machining lubricants or wetting agents is expressly forbidden without written approval from University.

3.12.5 The manufacturer shall have a method for precluding the entry of contaminants into or for separating contaminants from approved cutting fluid during the operation of their equipment. This requires a method of separating the way oil from the coolant, such as by the use of skimmers. This also requires that no unapproved fluid be allowed to blow onto the parts from the operation of hand tools (e.g., air sanders and grinders) or hydraulic machinery (e.g. sheetmetal punch). The seller shall have a documented system to maintain the coolant so as to minimize the contamination of the parts being processed.

3.12.6 Materials or parts should not come into contact with surfaces contaminated with organics during manufacture or storage (e.g., oily tables, oily clamps, or oily wooden blocks).

3.12.7 All surfaces and tapped and counter bored holes shall be thoroughly rinsed with clean water to remove all chips, debris and cutting fluid residues before such residues dry.

3.13. *Thermal treatments*: Furnace heating for material heat-treatment, stress relieving, annealing, brazing, clean-up, or any other process shall be performed under conditions that preclude or minimize the formation of surface oxides and discolorations ("Mill Scale[1]"). Such conditions include heat treatment in vacuum, inert gas or other protective (non-oxidizing) atmosphere. Cooling of components shall be performed by radiation in a protective atmosphere. Protective atmosphere shall be maintained until component has cooled to 50°C.

3.14. *Labeling:* Component labeling shall only be performed using techniques which are permanent and do not involve a paint or dye which could become a loose contaminant during precision cleaning or as the result of laser or flash lamp illumination. Specifically recommended marking techniques include those listed below in Table 2. Specifically prohibited marking techniques include those listed in Table 3 unless otherwise approved in writing by the University. Most labeling nomenclature is derived from MIL-STD-130. All labeling operations shall be performed before precision cleaning to insure the removal of any process chemicals or residues.

Table 2: Approved Marking Techniques

Diamond Engraving (without colored filler)
Machine Engraving (vibratory tool) using silicon carbide or tungsten carbide tools
Dot Peening (without colored filler)
Electrical Arc Pencil
Laser Engraving (Laser Marking) by vector process*
Metal Stamp

*Note: Industry provides two types of laser engraving. One is the "vector" process which uses the higher power YAG laser to remove material from the surface, leaving a permanent impression. The second uses the rastering process which involves a lower power CO_2 laser and a "dye;" this process is prohibited (see Table 3).

Table 3: Prohibited Marking Techniques

Acid Etching
Cast or Forged
Decalcomania
Electro-chemical Etch (Electrolytic Process)
Embossing
Metal or Plastic Tags
Molded
Painted
Rubber Stamp Stencil

Screen Printing
Silk Screening
Laser Engraving by rastering process

3.15. *Welding*. There shall be no evidence of cracks, incomplete fusion, inclusions, surface porosity, cold laps or voids in completed welds. Weld splatter, protrusions and any sharp edges shall be removed from the weld and adjacent areas. Completed welds shall not snag or grab approved clean room wipers. Completed welds shall have all oxidation and discoloration removed using stainless steel wire brushes or other means allowed in this MEL. Alloy 5356 shall be used for welding aluminum unless otherwise approved by the University[34].

[34] Silicon in the most common filler alloy for aluminum, 4043, is a source of particle contamination. Alloy 5356, in contrast, contains no silicon and produces welds that are easier to clean.

4. PACKAGING REQUIREMENTS

Completed product shall be packaged in accordance with the contract documents.

5. REVISION HISTORY

Rev	Description	Author	Date	Reviewed By	Date	Approved By	Date
OF	Revised per ECR Added additional cutting fluids to approved cutting fluid list.	Sudhir Jain	11/28/00	John Ertel Keith Primdahl Dennly Becker	11/28/00	Irving F. Stowers	11/28/00
OG	Revised per ECR 0003932 Added seven additional cutting fluids to the approved cutting fluid list [Blaser Blasocut 2000 CF, Castrol SYNTIL 9913, Clearedge 6519, Dascool 780, Permasol B, Safe Tap Plus, Vulcan Cutrite 2200, Blasocut Kombi, Blasocut 2000 Universal]. Deleted Castrol 6514 and CIMSTAR 3700 from the approved list of cutting fluids. Added the following cutting fluids to the amplifier approved list: Blasocut Kombi 883 (formerly Blaser 4000 CF), CIMSTAR 40 F, Dascool 2227, Dascool 2227B, Orion Synthetic 7397-2, Permasol B; removed section 3.1 which addresses the protection of sealing surfaces which is no-longer considered a cleanliness issue; Added section 3.13 on acceptable labeling techniques.	I .F. Stowers	November 19, 2001	Stanley Sommer George Hampton, Ernie Moor Jim Pryatel John Ertel John Honig William Gourdin	November 19, 2001	Irving F Stowers	November 19, 2001

OH	Revised per ECR 0006647. Added section requiring that fabrication equipment be fitted with features to prevent cutting fluid contamination. Added section requiring that packaging materials containing die release agents should not be allowed to come into contact with finished products. Removed acid & electrochemical etching as an acceptable marking procedure. Added machine engraving. Added details concerning minimum surface roughness requirements. Added a chemical etching technique to achieve a matt finish on stainless steel. Sealing surfaces are redefined as any surface so specifically marked on a drawing rather than being defined based on a specific numerical surface finish. Added Bos-Syn 210 and Valcool VNT 800 to the list of acceptable cutting fluids.	I. .F Stowers	August 26, 2003	Stanley Sommer George Hampton, Jim Pryatel William Gourdin	August 26, 2003	Irving F. Stowers	August 26, 2003
OJ	1. Deleted Valcool VNT 800 form the approved fluids, and added Hangsterfer's S-500, Master Chemical Trim C275, Metsol 675 and Mobil EDTXL. 2. Expanded discussion of protection of product from secondary unapproved fluids, such as way oil and hydraulic fluid. 3. Relaxed packaging requirements, including universal use of ULO and references to MEL99-012 and MEL99-014 (now refers to contract requirements).	Jim Pryatel	July 2004	Gary Jagoe William Gourdin Huy Le	July 2004	Chris Choate	July 2004

OK	1. Added surface finishes requirements to require removal of Mill Scale and, for aluminum, Mill finishes. 2. Modified the wording of the requirement that surfaces not snag or grab a clean room wiper. 3. Added requirement under cutting fluids to rinse all surfaces and tapped holes with clean water. 4. Re-titled and modified the wording of the thermal treatments section. 5. Added paragraph c to note of section 3.2 (Pryatel). 6. Added details to specification of acids in paragraph b of note in section 3.2. 7. Added hydraulic fluids to section 3.12 (Pryatel). 8. Updated the list of approved cutting fluids in section 3.12. 9. Added section 3.15 on welding.	William Gourdin	April 2006				
OL	1. Manufacturers' names, product numbers and contact information was updated/corrected. 2. Added Vulcan – Ultrasol 5720 to approved cutting fluids including Flashlamp application. 3. Added Hangsterfer's S-502 to approved cutting fluids (no Flashlamp application). 4. Added Blaser – Blasomill CSF 22 to approved cutting fluids (no Flashlamp application). 5. Omitted "during operation" from paragraph 3.12.5.	Richard Meissner James Pryatel William Gourdin	October 2006	William Gourdin George Hampton Huy Le	October 2006	William Gourdin	October 2006

OM	1. Added Castrol HYSOL MB50™ to approved cutting fluids list. 2. Added cross reference to Safe Tap Plus™ cutting fluid. 3. Added Qualichem Xtreme Cut 250™ to the approved cutting fluids list.	William Gourdin	March 2, 2012	George Hampton	March 2012	William Gourdin	March 2012
ON	1. Added Alumicut™ to the approved cutting fluids list. 2. Added Accu-Lube™ LB-2000 to the approved cutting fluids list. 3. Added Blaser Blasocut™ BC 20 to the approved cutting fluids list.	William Gourdin	July 5, 2012	George Hampton	July 2012	William Gourdin	July 2012
AC, OO	1. Added Oemeta Hycut™ CF 21 and Additiv™ BF 1:1	William Gourdin	April 10, 2013	George Hampton	April 2013	William Gourdin	April 2013
AD, OP	1. Added Blaser B-Cool™ 755 2. Added Hangsterfer's Hard Cut® 5518 3. Added Kool Mist Formula 77 4. Added Oemeta Novamet® 900	William Gourdin	November 18, 2013	George Hampton	November 2013	William Gourdin	November 2013
AE, OQ	1. Added QauliChem Q-Cut 245C to Section 3.12.2 2. Minor editorial changes	William Gourdin	May 11, 2016	William Gourdin	May 11, 2016	William Gourdin	May 11, 2016