0. OZEL SURECLER HIZMET BILDIRIMI

0.1. Isil islem kabiliyetleri dahil HSF tarafindan uygulanan tum ozel surecler sadece HSF bunyesindeki projeler kapsaminda uygulanir, HSF ucuncu taraf bir tedarikci amacli ozel surecler hizmeti saglamaz.

0.2. HSF Ozel Surecler Kabiliyetleri:

0.2.1. Isil Islem,

0.2.2. Yuzey Hazirlama: Ultrasonic, Buharli, Kumlama

0.2.3. Finish: Kuru (Solid) Film Yaglama, Cetyl Alcohol, Passivasyon, Aluminum Pigment

0.2.4. Laboratuvar Kabiliyetleri:
https://hsfaerospace.com/laboratory.html

0.2.5. Floresan Penetrant,

0.2.6. X-Ray radiography

0.3. HSF Kapsam Disi Urunler: Elektronik ekipmanlar, sensorler, elektronik kartlar, avionicler, kimyasallar ve benzeri urunler.

0.4. HSF Kapsam Disi Kabiliyetler: Kadminyum, gumus, cinko gibi kaplama uygulanmasi esnasinda insan sagligina kansorejen etkisi olan tum surecler HSF kabiliyetleri disindadir.

0. *SPECIAL PROCESSES SERVICE STATEMENT*

0.1. *All special process implemented by HSF, including heat treatment capabilities, are applied only for the projects implemented by HSF; HSF does not provide special process services as a third-party supplier to any clients.*

0.2. HSF Special Process Capabilities:

***0.2.1. Heat Treatment**,*

***0.2.2. Surface Treatment:** Ultrasonic, Vapor, Grit Blasting*

***0.2.3. Finish:** Solid Film Lubrication, Cetyl Alcohol, Passivation, Aluminum Pigment*

0.2.4. Laboratory Capabilities:
https://hsfaerospace.com/laboratory.html

***0.2.5. Fluorescent Penetrant**,*

0.2.6. X-Ray Radiography

***0.3. HSF Out-of-Scope Products:** Electronic equipment, sensors, electronic boards, avionics, chemicals, and similar products.*

***0.4. HSF Exclusions:** All processes involving materials such as cadmium, silver, and zinc that have a carcinogenic effect on human health during coating application are outside the scope of HSF's capabilities.*

1. BASLANGIC

1.1. Bu el kitabi, HSF Savunma Havacilik Ltd. Sti. (**HSF**) tarafindan uygulanan isil islem surecleri icin genel kosullari belirlemektedir.

1.2. Urun kosullarina ve/veya ham madde durumuna bagli olarak isil islem sureci guncellenebilir veya degistirilebilir. Yetkilendirilmis muhendis her zaman ilgili standardlari, uygulamalari ve deneyimleri dikkate almalidir.

1.3. Bu el kitabi, firin ekipman gereklilikleri, firin control ve surec yonetimi, kalite control test uygulamalarina iliskin genel bilgilerin yani sira isil islem operator gereklilikleri, periyodik (onleyici) bakimlar ve kalibrasyon gerekliliklerini de kapsamaktadir.

1.4. Bu el kitabinda yer alan bilgiler, HSF tarafindan uygulanan uretim ve kalite kontrol surecleri kapsaminda uluslararasi standardlar ve musteri gereksinimleri dikkate alinarak hazirlanmistir.

1.5. Uygulama Standardi: Bu el kitabinin konulari **AMS2750™ Pyrometry** Standardi ve **SAE ARP1962 Training and Approval of Heat-Treating Personnel** referans uygulamalar dokumani temel alinarak hazirlanmisdir.

1.6. Kullanici Seviyesi: Bu egitim el kitabinin **kullanici seviyesi**

- √ hizmet ici **egitimini tamamlamis**,
- √ HSF ERP uzerinden yurutulen "**Heat Treatment Training**" surecini basariyla **tamamlamis** ve **sertifikanlanmis**,
- √ **en az 6 ay** HSF bunyesinde isil islem unitesinde hizmet almis,
- √ isil islem surecini **degerlendirebilecek** muhendislerdir.

1. *INTRODUCTION*

1.1. *This handbook establishes general requirements for the heat treatment processes performed by HSF Savunma Havacilik Ltd. Sti. (**HSF**).*

1.2. *Depending on the product conditions and/or raw material status, the heat treatment process can be updated or changed. The authorized engineer should always consider relevant standards, experiences, and practices.*

1.3. *This handbook covers furnace equipment requirements, furnace control and process management, quality control testing applications, heat treatment operator requirements, periodic (preventive) maintenance, and calibration requirements.*

1.4. *The information contained in this handbook has been prepared in accordance with international standards and customer requirements, within the scope of the production and quality control processes implemented by HSF.*

***1.5. Reference Standard:** This handbook has been prepared based on the **AMS2750™ Pyrometry** Standard and **SAE ARP1962 Training and Approval of Heat-Treating Personnel** reference document.*

***1.6. User Level:** The **user level of this handbook** is engineers who*

- √ ***have completed** in-service heat treatment training,*
- √ *Having successfully **completed** and been **certified** in the "Heat Treatment Training" process conducted through HSF ERP,*
- √ ***worked** in the heat treatment unit for at least six months within HSF,*
- √ ***can evaluate** the heat treatment process.*

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1.7. Yeterli isil islem egitimi olmayan muhendisler ve operatorler bu klavuzun **kapsam disindadir**.

1.8. Online Ziyaretci Sorumlulugu: Bu dokumanda yer alan bilgiler HSF fabrika alani ve uretim surecleri dikkate alinarak hazirlanmistir. Online ziyaretciler bu dokumanda yer alan bilgileri kendi kapasiteleri kapsaminda kullanmasindan sorumludur, HSF'nin her hangi bir sorumlulugu yoktur.

1.9. Risk Degeri: HSF Kalite Kontrol ve Surec Onay (**QCPA**) politikasina gore, **Isil Islem** uygulama sureclerinin risk degeri "**P: Yuksek – S: Cok Yuksek = Cok Yuksek (20 – 25) Duzeltici Faaliyet Gerekli**" olarak siniflandirmistir.

1.10. Bu el kitabi HSF Isil Islem Firini Kullanim Klavuzunun bir parcasidir ve tum kullanicilar bu iki klavuzu ve diger gerekli tum standardlari birlikte degerlendirmelidir.

1.11. Bu egitim el kitabinda verilen sicaklik ve sure degerleri, veya diger her turlu bilgi HSF bunyesinde uygulanan isil islem sureclerini kapsar. **Isil islem uygulanacak hammaddenin dokum kosullarina bagli olarak bu verilerde degisme olabilir**. Bu nedenle, hammadde birden fazla lot veya tedarikci tarafindan saglaniyorsa mutlaka bu lotlar birbirinden ayri tutulmali ve her lot icin isil islem sahit numune sureci ayri uygulanmalidir.

1.12. Bu kullanici el kitabi celik ve paslanmaz celik hammaddelerini kapsamaktadir; titanyum, aluminyum ve diger hammaddeler icin lutfen teknik destek isteyin.

Guvenlik ve Tehlikeli Maddeler:

√ *Bu el kitabinda aciklanan veya atifta bulunulan materyeller, yontemler, uygulamalar ve islemler, tehlikeli maddelerin kullanimini icerebilse de, bu el kitabi bu tur malzemelerin kullanimini ele almamaktadir.*

√ *Tehlikeli maddelerin guvenli ve dogru kullanimi ve ilgili tum personelin saglik ve guvenligini saglamak icin gerekli onlemleri almak tamamen isil islem surecini uygulayicisi ve surec yonetici muhendis sorumlulugundadir.*

1.7. *The engineers whose do not enough heat treatment training and the operators are **excluded** from this manual.*

1.8. Online Visitor Responsibility: *The information in this document has been prepared considering the HSF factory area and production processes. Online visitors are responsible for using the information in this document within their own capacity, HSF has no responsibility.*

1.9. Risk Value: *According to the HSF Quality Control and Process Approval (**QCPA**) policy, the risk level of the **Heat Treatment** processes is classified as "**P: High – S: Very High = High (20 – 25) Corrective Action Required**".*

1.10. *This handbook is a part of the HSF Heat Treatment Furnace User Manual, and all users should consider these two manuals and all required standards together.*

1.11. *The temperature and time given in this handbook, or any other information, are valid for the heat treatment processes conducted by HSF. **These data may change depending on the casting conditions of the raw material**. For this reason, if the raw material is provided by more than one lot or suppliers, these lots must be kept separate from each other, and the heat treatment witness sample process must be applied separately for each lot.*

1.12. This handbook covers the steel and stainless-steel raw materials; for titanium, aluminum, and others, please ask for technical support.

Safety - Hazardous Materials:

√ *While the materials, methods, applications, and processes described or referenced in this handbook may involve the use of hazardous materials, this handbook does not address the hazards that may be involved in such use.*

√ *It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.*

2. UYGULANAN STANDARDLAR

2.1. HSF bunyesinde uygulanan isil islem ve alt-surecler asagidaki standardlar dikkate alinarak planlanmakta, uygulanmakta, kalite kontrolleri gerceklestirilmete ve tum surec izlenebilirligi raporlanmaktadir. **Musteri tarafindan ozel bir standard istenmedigi surece HSF bu standardlarin son versiyonunu uygular**.

2.2. Revizyon ve Gecerlilik Durumu: Atifta bulunulan standardin iptal edilmesi ve yerine gececek standardin belirtilmemesi durumunda, soz konusu belgenin yayinlanan son revizyonu gecerli olur.

2.3. Oncelik Durumu: Musteri tarafindan aksi belirtilmedigi surece, bu el kitabinda referans verilen standardlar HSF tarafindan uygulanan tum Isil Islem surecleri icin oncelikli olacaktir.

2. APPLICABLE DOCUMENTS

2.1. *The heat treatment and sub-processes applied within HSF are planned, implemented, and the quality controls carry out, and the entire process traceability is reported considering the following standards. **Unless a specific standard is requested by the customers, HSF implements the final revision of these standards**.*

2.2. Revision and Validity Status: *When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.*

2.3. Priority Status: *Unless otherwise specified by the customer, the standards referenced in this handbook will take priority for all Heat Treatment processes implemented by HSF.*

REFERENCE	STANDARD DESCRIPTION
AMS2750	Pyrometry
AS7766	Terms Used in Aerospace Metals Specifications

AMS2769	Heat Treatment of Parts in a Vacuum
AMS2761	Heat Treatment of Steel Raw Materials
AMS2774	Heat Treatment Nickel Alloy and Cobalt Alloy Parts
AMS2801	Heat Treatment of Titanium Alloy Parts
AMS-H-81200	Heat Treatment of Titanium and Titanium Alloys
AMS2759	Heat Treatment of Steel Parts, General Requirements
AMS2759/1	Heat Treatment of Carbon and Low-Alloy Steel Parts Minimum Tensile Strength Below 220 ksi (1517 MPa)
AMS2759/2	Heat Treatment of Low-Alloy Steel Parts Minimum Tensile Strength 220 ksi (1517 MPa) and Higher
AMS2759/3	Heat Treatment Precipitation-Hardening Corrosion-Resistant, Maraging, and Secondary Hardening Steel Parts
AMS2759/4	Heat Treatment Austenitic Corrosion-Resistant Steel Parts
AMS2759/5	Heat Treatment Martensitic Corrosion-Resistant Steel Parts
AMS2759/9	Hydrogen Embrittlement Relief (Baking) of Steel Parts
AMS2759/11	Stress Relief of Steel Parts
AMS-H-6875	Heat Treatment of Steel Raw Materials
ARP1962	Training and Approval of Heat-Treating Personnel
ARP1917	Clarification of Terms Used in Aerospace Metals Specifications
AS7766	Terms Used in Aerospace Metals Specifications
ASTM E220	Standard Test Method for Calibration of Thermocouples By Comparison Techniques
ASM HANDBOOK	Heat Treating – Volume 4

3. TANIMLAR VE KISALTMALAR
(Tam Liste Icin Lutfen AS7776 Standardina Bakin**)**

3.1. TUT: Sicaklik Esdeger Toleransi
3.2. SAT: Sistem Esdeger Testi
3.3. TUS: Sicaklik Esdeger Testi
3.4. WS: Sahit Numune
3.5. PAQL: Surec Kabul Edilebilir Kalite Seviyesi
3.6. Set Value (SV): Istenen Sicaklik
3.7. Point Value (PV): Mevcut Sicaklik
3.8. Sapma (Hata): Isil islem icin uygulanan gereklilik kapsaminda firinin mevcut sicakligi (**PV**) ile istenen sicakligi (SV) arasindaki farkdir. (Mevcut Sicaklik – Istenen Sicaklik = Sapma (Hata))
3.9. Aralik: Bir kalibrasyon, test veya sensor degisim tarihinden veya gununden (tarih gun dahil dahil) bir sonraki kalibrasyon, test veya sensor degisimin icin sonraki takvim gunu.
3.10. Kalibrasyon: Uygulanan standard kapsaminda bir ekipman veya sensorun ciktilarinin standard gereksinimlerini tam karsiladigindan emin olmak icin sensor veya ekipmandan bir veya birden fazla olcum alinarak ve ciktilardaki sapmalarinin potansiyel ayarlamalarinin standarda bagli olarak duzeltilmesi.
3.11. Kontrol Bolgesi: Isil islem ekipmaninin calisma bolgesinin bir bolumunde, sicakligini kontrol etmek icin ayri bir sensor, cihaz ve isitma veya sogutma sistemi bulunur. Isil islem ekipmaninin bu bolumu bagimsiz olarak kontrol edilir.

3. DEFINITIONS AND ABBREVIATIONS
(See AS7776 Standard for Whole Definition List)

3.1. TUT: *Temperature Uniformity Tolerance*
3.2. SAT: *System Accuracy Test*
3.3. TUS: *Temperature Uniformity Survey*
3.4. WS: *Witness Sample*
3.5. PAQL: *Process Acceptance Quality Level*
3.6. Set Value: *Set Temperature (SV)*
3.7. Point Value: *Point Temperature PV*
3.8. Deviation (Error): *In the context of the requirement, the difference between the set temperature (**SV**) and the point temperature (**PV**) (Indicated Temperature - True Temperature = Deviation/Error).*
3.9. Interval: *The calendar days from the day/date a calibration, test, or sensor replacement was performed and the next day/date a calibration, test, or sensor replacement is due (inclusive).*
3.10. Calibration: *An assessment of the accuracy of a sensor or an instrument to a traceable standard sensor and/or field test or standard instrument, based on one or more measurements, and potentially adjusting an instrument and/or compiling a deviation chart for a sensor or instrument to ensure compliance with requirements.*
3.11. Control Zone: *A portion of the working zone in thermal processing equipment has a separate sensor, instrument, and heating or cooling system to control its temperature. This portion of the thermal processing equipment is independently controlled.*

3.12. Urun Sensoru: Isil islem uygulanacak urune direk temas eden veya belli bir bolgenin sicakligini mevcut sistemden bagimsiz olarak takip etme imkani saglayan, sicaklik takip ekipmani ve yazilimidir.

3.12. Load Sensor: *This is temperature-monitoring equipment and software that either directly contacts the product to be heat-treated or independently monitors the temperature of a specific area in the furnace.*

4. SOZLESME YONETIMI

HSF hicbir kosulda ucuncu taraf firmalara isil islem hizmeti saglamamaktadir. HSF isil islem kabiliyetleri sadece HSF bunyesinde yurutulen uretim surecleri icin gecerlidir.

4.1. Teklif Degerlendirme ve Isil Islem Kabiliyetleri: HSF tarafindan yurutulen projelerde eger hammadde veya urun icin isil islem gereksinimi gerekiyorsa, teklif degerlendirme surecine isil islem risk degeri eklenir ve HSF isil islem kabiliyetlerine (**bolum 5'e bakin**) bagli olarak projeye onayi verilir veya proje red edilir.

4.2. Referans Standard: Aksi musteri tarafindan belirtilmedigi surece HSF bunyesinde yurutulen tum isil islem surecleri bu kalite el kitabinin 2nci maddesinde belirtilen standardlara gore yapilir ve raporlanir.

4.3. Hammadde Mulkiyeti: Siparis kapsaminda hammadde musteri mulkiyetinde ise, tum isil islem surecleri icin musteri onayi on kosuldur.

4.4. Hammadde Mulkiyeti: Sipris kapsaminda hammadde HSF mulkiyetinde ise, isil islem surecleri icin aksi musteri tarafindan belirtilmedigi surece musteri onayina ihtiyac duyulmaz.

4.5. Yeniden Isil Islem: Musteri mulkiyetindeki hammaddelerde isil islem sureclerinde yeniden isil islem (reheat treatment) gerekmesi durumunda musteri onayi alinmasi sartdir.

4.6. Yeniden Isil Islem: HSF mulkiyetindeki hammaddelerde yeniden isil islem gerekmesi durumda urun siniflandirmasina bakilmaksizin musteri tarafindan aksi belirtilmedigi surece musteri bilgilendirmesi ve onayi sartdir.

4.7. Urun Teslimat Programi: Isil islem sureclerinde yasanan olumsuzluklar urun teslimat programini etkiliyorsa musteri bilgilendirilmesi yapilir.

4.8. Kalite Onay Formu: Isil islem uygulanan tum projeler icin isil islem kalite formunun nihai urun kalite formuna eklenmesi sartdir.

4. CONTRACT REVIEW

Under no circumstances does HSF provide heat-treatment services to the customers. HSF heat treatment capabilities are only used for the projects conducted within HSF.

4.1. Quotation Evaluation and Heat Treatment Capabilities: *For the projects conducted by HSF, if heat treatment is required for the raw material or product, a heat treatment risk assessment is included in the quotation evaluation process, and the project is approved or rejected based on HSF's heat treatment capabilities (**see section 5**).*

4.2. Reference Standard: *Unless otherwise specified by the customer, all heat treatment processes carried out within HSF are performed and reported in accordance with the standards specified in Article 2 of this quality manual.*

4.3. Raw Material Property: *If the raw material is the customer's property, customer approval is a prerequisite for all heat treatment processes.*

4.4. Raw Material Property: *If the raw material is under HSF property, customer approval is not required for heat treatment processes unless otherwise specified by the customer.*

4.5. Reheat Treatment: *If reheat treatment is required in the heat treatment process for customer-owned raw materials, customer approval is mandatory.*

4.6. Reheat Treatment: *If re-heat treatment is required for raw materials owned by HSF, customer notification and approval are mandatory, regardless of product classification, unless otherwise specified by the customer.*

4.7. Product Delivery Schedule: *If any issues during the heat treatment process affect the product delivery schedule, the customer will be informed.*

4.8. Quality Approval Form: *For all heat treatment projects, the heat treatment quality form must be attached to the final product quality form.*

5. ISIL ISLEM KABILIYETLERI

HSF bunyesinde yurutulebilen isil islem surecleri yurutulen projelere ve musteri onayina bagli olarak asagida siralanmisdir.

5. HEAT TREATMENT CAPABILITIES

The heat treatment processes are listed below that can be carried out by HSF, subject to project and customer approval.

RAW MATERIAL	STANDARD	CAPABILITY	OUT-OF-SCOPE	TERMS
STEEL	AMS2759 AMS2761	X		Customer Approval
CRES	AMS2759/3 AMS2759/4 AMS2759/5	X		Customer Approval
NICKEL & COBALT	AMS2774	X		Customer Approval
TITANIUM	AMS2801 AMS-H-81200	X		Customer Approval FAI (AMS9102/C)
STRESS RELIEF	AMS2759/11	X		

6. AMS2750 GEREKSINIMLERI

6.1. AMS2750 kapsaminda HSF tarafindan kullanilan firinlarin ve donanimlarin genel ozellikleri:

6.1.1. Surec ve Sicaklik Kontrolu: Tam otomatik, dokunmatik PLC kontrol unitesi,

6.1.2. Surec ve Sicaklik Kontrolu: Manuel surec kontrol unitesi

6.1.3. Temassiz Sicaklik Kontrolu: Pyrometer

6.1.4. Isitici Elemanlar: "U" tipi SCR isitici – Max. 1500 ^{0}C (2732 ^{0}F)

6.1.5. Periyodik Degisim: Yillik

6.1.6. Thermocouple – Sinif: Noble Metal veya normal

6.1.7. Thermocouple – Tip: S veya K

6.1.8. Thermocouple – Kapsam: 1400 ^{0}C (2552 ^{0}F)

6.1.9. Thermocouple – Izlenebilirlik: NIST ve/veya CNAS

6.1.10. Load-Sensor: Inconel Alloy 1300 ^{0}C (2372 ^{0}F)

6.1.11. Thermocouple Kalibrasyon Dogrulama: ASTM E220

6.1.12. Thermocouple Kalibrasyon Dogrulama Zamani: uretici ambalaji acilmadigi surece kullanim oncesi, eger uretici ambalaji kullanim amaci olmadan acilirsa, tekrar ambalajlama oncesi.

6.1.13. Kalibrasyon Dogrulayici Enstruman Kalibrasyonu: Yillik, ISO17025 izlenebilirligi olan harici laboratuvar.

6.1.14. Kalibrasyon Adimi: 100 ^{0}C (200 ^{0}F)

6.1.15. Tekrar Kullanilabilirlik: Sinirlama yok

6.1.16. Thermocouple – Kalibrasyon Dogrulama Etiketi: En az asagidaki bilgileri icermelidir

6.1.16.1. Ekipman veya Firin No,

6.1.16.2. Thermocouple Tipi,

6.1.16.3. Thermocouple Seri No ve Izlenebilirlik,

6.1.16.4. Kalibrasyon Tarihi,

6.1.16.5. Kalibrasyon Son Gecerlilik Tarihi,

6.1.16.6. Kalibrasyon dogrulamayi Yapan muhendis ID,

6.1.16.7. Kalibrasyon Limitleri.

6. *AMS2750 REQUIREMENTS*

6.1. In the scope of AMS2750, the general specifications of the furnaces and equipment used by HSF:

6.1.1. Process and Temperature Controller: *Fully automatic, touchscreen PLC control unit,*

6.1.2. Process and Temperature Controller: *Manual control unit.*

6.1.3. Non-Installed Temperature Controller: *Pyrometer*

6.1.4. Heating Element: *"U" type SCR heating – Max. 1500 ^{0}C (2732 ^{0}F)*

6.1.5. Replacement Scherdule: *Annually*

6.1.6. Thermocouple – Class: *Noble Metal or normal*

6.1.7. Thermocouple – Type: *S or K*

6.1.8. Thermocouple – Range: *1400 ^{0}C (2552 ^{0}F)*

6.1.9. Thermocouple – Traceability: *NIST and/or CNAS*

6.1.10. Load-Sensor: *Inconel Alloy 1300 ^{0}C (2372 ^{0}F)*

6.1.11. Thermocouple Calibration Verification: *ASTM E220*

6.1.12. Thermocouple Calibration Verification Time: *before use, provided the manufacturer's packaging remains unopened; if the manufacturer's packaging is opened for any purpose other than use, before repackaging.*

6.1.13. Calibration Verification Instrument Calibration: *Annual, external laboratory with ISO17025 traceability.*

6.1.14. Calibration Steps: *100 0C (200 0F)*

6.1.15. Reuse: *No other restrictions*

6.1.16. Thermocouple – Calibration Verification Sticker: *As a minimum, the information shall include:*

6.1.16.1. *Instrument or Furnace Number,*

6.1.16.2. *Thermocouple Type,*

6.1.16.3. *Thermocouple Serial Nr. and traceability,*

6.1.16.4. *Calibration Date,*

6.1.16.5. *Calibration Due Date,*

6.1.16.6. *Engineer ID for the calibration verification,*

6.1.16.7. *Calibration Limits*

6.2. Firin Siniflari – HSF Firin Kabiliyetleri

6.2. Furnace Classes – HSF Furnace Capabilities

FURNACE CLASSES			*INSTRUMENT TYPE AND REQUIREMENT*						
CLASS	*TUT ^{0}F*	*TUT ^{0}C*	*REQUIREMENTS*	*A*	*B*	*C*	*D+*	*D*	*E*
1	*5+/-*	*3+/-*	*1 Control Sensor & Display Temp*	*X*	*X*	*X*	*X*	*X*	*X*
2	*10+/-*	*6+/-*	*Second Control Recorder*	*X*	*X*	*X*	*X*	*X*	
3	*15+/-*	*8+/-*	*2 Additional Control Recorder*	*X*		*X*			
4	*20+/-*	*10+/-*	*1 Load Sensor*	*X*	*X*				
5	*25+/-*	*14+/-*	*Over-Temperature Protection*	*X*	*X*	*X*	*X*	*X*	
6	*50+/-*	*28+/-*	*Hottest and Coldest Temperature Sensor*	*X*		*X*			

6.3. SISTEM DOGRULUK TESTI (SAT) VE TEST ARALIGI

6.3. SYSTEM ACCURACY TEST (SAT) INTERVAL

FURNACE	*MINIMUM*	*NORMAL*	*EXTENDED*	*MINIMUM SAT DIFFERENCE*

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CLASS	INSTRUMENT	SAT	SAT	^{0}F (+/-)	^{0}C (+/-)	% READING
1	A / B	MONTHLY	QUARTERLY	2.00	1.10	0.20
2	A / B	MONTHLY	QUARTERLY	3.00	1.70	0.30

6.4. SICAKLIK ESDEGER TESTI (TUS) VE UYGULAMA ARALIGI

6.4. TEMPERATURE UNIFORMITY SURVEYS (TUS) INTERVAL

FURNACE CLASS	MINIMUM INSTRUMENT	NORMAL TUS	SUCCESSFUL PERIOD	EXTENDED TUS	MAXIMUM PERMITTED OFFSET ^{0}F (+/-)	^{0}C (+/-)	% READING
1	A / B	MONTHLY	2	SEMIANNUALLY	2.50	1.50	N/A
2	A / B	MONTHLY	4	QUARTERLY	5.00	3.00	N/A

7. ISIL ISLEM ONCESI KONTROLLER

7. PRE-CHECKS BEFORE HEAT TREATMENT

Bu bolumde anlatilan tum adimlar HSF firin kabiliyetleri ve is disiplini kapsamindadir.

All steps described in this section pertain to the HSF furnaces' capabilities and business discipline.

KONTROL *CONTROL*	ACIKLAMA *DESCRIPTION*	MUHENDIS *ENGINEER*	OPERATOR *OPERATOR*
Is Emri ***Work Order***	Is emri formu mutlaka doldurulmali ve isil islem muhendis kontrolu saglanmalidir. *The work order form must be completed and checked by a heat treatment engineer.*	X	
Urun Tanimlama Etiketi ***Product Description Label***	Isil isleme girecek urunler mutlaka urun tanimlama etiketi olmalidir. Isil isleme alinacak urunler hicbir kosul altinda isil islem alani disinda tutulmamalidir. *Products to be heat-treated must have product identification labels. Products to be heat-treated must not be kept outside the heat-treating area under any circumstances.*	X	X
Urun ***Product***	Is emrinde ve urun tanimlama etiketinde yazan hammadde boyu, hammadde capi, hammadde tipi, ve uygulanacak surec bilgisi mutlaka control edilmelidir. *The raw material length and dia, material type, and the process information as stated in the work order and product description label, must be checked.*	X	X
Temizlik – Urun ***Cleaning – Product***	Hic bir kosul altinda isil islem uygulanacak urunlerde kaplama, yag, tiner veya benzeri dis etken bulunmamalidir, bu durum isil islem icin uygulanan tum surecler icin gecerlidir. Under no circumstances should any coating, oil, thinner or similar external factors in the products to be heat treated, this applies to all processes used for heat treatment.		X
Temizlik – Firin ***Cleaning – Furnace***	Firin temizligi haftalik olarak yapilmalidir, firin icinde is guvenligini ve surec guvenligini etkileyici hicbir dis etken veya onceki isil islemlerden kalma metaryeller bulunmamalidir. *Furnace cleaning should be performed weekly, and the furnace should be free of any external materials left from previous heat treatments that could affect occupational and process safety.*		X
Raf ve Sepet ***Rack and Basket***	Isil islem sureclerinde kullanilacak raf veya sepetler Inconel sacdan imal edilmis ve mutlaka sicak hava akiskanligini saglayici olmalidir. *Racks or baskets used in heat treatment processes must be made of Inconel sheet and must ensure hot air circulation.*	X	
Raf Sepet Yerlesim ***Rack Basket Placement***	Firin icine yerlestirilecek sepet, isiticilara ve thermocoupla direk temas etmemelidir. Raflar hava akiskanligini onleyecek sekilde yerlestirilmemelidir. Birden cok raf ust uste yerlestirilecekse mutlaka raf yukseltme uygulanmalidir. *The racks to be placed inside the furnace should not come into direct contact with the heaters and thermocouple. Racks should not be positioned in a way that prevents airflow. If multiple racks are to be placed, rack height adjustments must be made.*	X	X
Urun Yerlesim ***Product Placement***	Isil islem uygulanacak urunler sepete yerlestirilirken, firin icinde sicak hava dolasimini kesecek veya degistirecek sekilde olmamalidir. When placing products in the furnace, they should not be positioned in a way that will interrupt or alter the hot–air circulation inside the furnace.	X	
Urun Agirligi ***Product Weight***	Isil islem surecleri oncesi mutlaka isil islem muhendisi ve operatoru urun agirlik kontrolunu yaplamlidir. Cunku urun sicak agirligi soguk agirligindan hem daha agir hem de cok tehlikelidir. *Before heat treatment process, the engineer and operator must verify the product weight. This is because the hot weight of the product is both heavier and much more dangerous than its cold weight.*	X	X
Firin Mekanik – Valf ***Furnace Mechanic – Valve***	Sistemin kuru calistirilmasi durumunda tum vanalar kapali olmalidir, vakumla calisiyorsa lutfen kullanici klavuzuna bakin. If the system is run dry, all valves must be closed. If the system is running vacuum, please check the user manual for instructions.		X
Firin Mekanik – Su Sogutucu	Kesinlikle su sogutucu hattinda kacak olmamalidir ve firin calisma suresi boyunca su sogutucu acik olmalidir.		X

Furnace Mechanic – Water Chiller	*There must be no leaks in the water chiller line, and the water chiller must remain on throughout the furnace process time.*		
Firin Mekanik – Isiticilar ***Furnace Mechanic – Heating Elements***	Isiticilarda catlak veya kirik olmamalidir, cunku catlak veya kirik isitici firinin calismasini ve isil islem surecini direk olumsuz etkiler. *The heaters must not have any cracks or breaks, as they negatively affect the furnace's operation and process.*		**X**
Firin Mekanik – Load Sensor ***Furnace Mechanic – Load Sensor***	Isil islem surecinde kulanilacak load sensor(ler) mutlaka urune temas etmesi saglanmalidir. *The load sensor(s) used in the heat treatment process must be in contact with the product.*	**X**	
Surec Kontrolu – Program ***Process Control – Program***	Isil islem surecinde uygulanacak program firin control unitesinden ayarlanmalidir. Uygulanacak isil islem program hammaddeye, urun boyutlarina ve miktarina bagli olarak degisiklik gosterebilir. *The heat treatment program to be applied during the process must be set from the furnace control unit. The heat treatment program to be applied may vary depending on the raw material, product dimensions, and quantity.*	**X**	

8. URUN YERLESIMI VE RAFLAMA

GUVENLIK UYARISI

Isil islem surecleri icin en onemli konulardan birisi isil islem firinina urun yerlesimi konusudur. Yanlis yerlestirilmis veya onceden planlanmamis urun yerlestirmeler isil islem sureclerinde hayati tehlike olusturur. (**Risk detayi icin 15.8 ve 15.9' a bakin**)

8.1. Planlama: Firin ici urun yerlesimi yapilmadan once mutlaka urun yerlestirme planlamasi yapilmalidir.

8.2. Raflarin Fiziki Sekli: Isil islem sureclerinde kullanilacak raflar hem hava sirkulasyonunu hem de urun yerlesimini etkilemeyecek sekilde olmalidir.

8.3. Raf Kontrolu: Urunler raflanacaksa mutlaka firin yerlesimi oncesi firin disi ortamda raf agirlik kontrolu yapilmalidir.

8.4. Raf Tasiyici Ekipmanlari: Urunler raflanacaksa mutlaka raflar icin tasiyici ekipmanlarin saglamlik kontrolu yapilmalidir.

8.5. Hava Sirkulasyonu: Ister raflama ister direk yerlesim olsun, urun yerlesimi asla firin ici hava sirkulasyonunu etkileyecek sekilde olmamalidir.

8.6. Isiticilarla Temas: Ister raflama ister direk yerlesim olsun, urunlerin veya raflarin isiticilarla direk temasi olmamalidir.

8.7. Merkezleme: Ister raflama ister direk yerlesim olsun, urun yerlesimi firinin ic yapisina gore merkezleme seklinde olmalidir.

8.8. Bitmis Urunler: Bitmis urunlerin isil isleme surecine dahil edilmesi sadece uretim standardinda veya musteri onayi ile olabilir.

8.9. Asiri Hassas Yuzeye Sahip Urunler: Asiri hassas yuzeye sahip urunlerin isil islemi sadece musteri onayi ile olur. Bu turden urunler icin ozel raflama teknikleri kullanilmasi gerekebilir.

8. PRODUCT PLACEMENT AND RACKING

SAFETY WARNING

*One of the most important issues in heat treatment processes is product placement in the furnace. Incorrect or unplanned product placements pose a life-threatening risk in heat treatment processes. (**See 15.8 and 15.9 for detailed risk assessment**)*

8.1. Planning: *Before placing products inside the furnace, a product placement plan must be prepared.*

8.2. Physical Shape of Rack: *The racks used in heat treatment processes must be designed in a way that does not affect both air circulation and product placement.*

8.3. Rack Inspection: *A rack weight check must be performed outside the furnace before placement.*

8.4. Rack Support Equipment: *If products are to be racked, the structural integrity of the support equipment for the racks must be checked.*

8.5. Air Circulation: *Whether racking or direct placement, product placement should never affect the air circulation inside the furnace.*

8.6. Contact with Heaters: *Products or racks should not be in direct contact with heaters.*

8.7. Centering: *Whether using shelves or direct placement, product placement should be centered according to the furnace's internal structure.*

8.8. Finished Products: *Heat treatment of finished products may be carried out only in accordance with production standards or with customer approval.*

8.9. Products with Extremely Sensitive Surfaces: *Heat treatment of products with extremely sensitive surfaces may only be carried out with customer approval. Special racking may be required for these types of products.*

9. ISIL ISLEM IS EMRI

9.1. HSF bunyesinde uygulanacak tum isil islem surecleri icin yetkili muhendis tarafindan hazirlanmis bir Is Formu gereklidir.

9.2. Isil Islem Is Emri formu en az asagidaki bilgileri icermelidir:

9.2.1. Proje No,

9.2.2. Tarih – Saat,

9. HEAT TREATMENT WORK ORDER

9.1. It is mandatory to prepare a Work Order form that is prepared by the authorized engineer for all heat treatment processes to be applied within HSF.

9.2. The Work Order Form must include minimum following:

9.2.1. Project Number,

9.2.2. Date – Time,

9.2.3. Hammadde Adi ve Standardi,
9.2.4. Hammade Boyutlari (*),
9.2.5. Hammadde Kimyasal Analiz Raporu,
9.2.6. Hammadde Mevcut Sertlik,
9.2.7. Istenen Sertlik,
9.2.8. Isil Islem Surec ve Standardi,
9.2.9. Soak Derecesi ve Zamani,
9.2.10. Sogutma Sekli ve Suresi,
9.2.11. Sahit Numune Resimleri,
9.2.12. Yetkili muhendis kase ve imza

(*) Eger urun vida somun v.b. cok ve karmasik boyutluysa en kucuk ve en buyuk degerler birlikte belirtilir.

9.2.3. Raw Material Name and Standard,
9.2.4. Raw Material Dimensions (*),
9.2.5. Raw Material Chemical Analysis report,
9.2.6. Raw Material Current Hardness,
9.2.7. Required Hardness,
9.2.8. Heat Treatment Process and Standard,
9.2.9. Soak Temperature and Time,
9.2.10. Quenching Type and Time,
9.2.11. Witness Sample Pictures,
9.2.12. Authorized engineer stamp and signature

(*) If the product has complex dimensions like as bolts, the minimum and maximum values are determined together.

10. SAHIT NUMUNE (SAMPLE PRODUCT)

10.1. HSF uretim ve kalite kontrol sureclerinin en onemli temel taslarindan birisi **Sahit Numune** (**WS**) politikasidir.
10.2. **WS** politikasi tum isil islem sureclerinde aktif olarak uygulanir.
10.3. Isil islem sureclerinde kullanilacak **WS** sayisi urune gore degismektedir.
10.3.1. **Hammadde isil Islemleri:** Hammaddenin boyutlarina bagli olarak degiskenlik gostermekle birlikde en az 5cm (1.9685 inch) boyutlarinda farkli cubuklardan alinmis en az 5 numune.
10.3.2. **Nihai (Finish ve Kaplama oncesi) Urun Isil Islemleri:** Urun AQL miktarina bagli olarak secilir. Urun yerlesimi ve firin ici homojen isi dagilimi icin icin ozel raflama gerekir.
10.3.3. **Asiri Hassas Yuzeye Sahip Urunler:** bu turden urunlere uygulanacak isil islem surecleri sadece musteri onayi ile olur. Sahit numune sayisi musteri tarafindan belirlenmelidir.
10.4. **Sahit Numune Secimi:** Aksi musteri isterlerinde veya uretim standardinda belirtilmedigi surece, Rastgele Numune Secme yontemi kullanilir.
10.5. **Sahit Numune Verileri:** Sahit numuneye ait asagidaki veriler, numune uygunsa numunenin uzerine kazima yontemi veya numune uygun degilse numune etiketi ile belirtilmelidir:
10.5.1. HSF Referans No,
10.5.2. Tarih,
10.5.3. Isil Islem Lot No
10.5.4. Hammadde Cinsi ve Ebatlari
10.5.5. Sertlik Degeri – Depo Cikis (**CH XX.XX HRC**)
10.5.6. Sertlik Degeri – Sertlestirme (**HH XX.XX HRC**)
10.5.7. Sertlik Degeri – Temper (**TH XX.XX HRC**)
10.6. **Sahit Numunenin Fotograflanmasi:** Sirali numunlerin fotografi cekilir,

10. WITNESS PRODUCT (SAMPLE PRODUCT)

10.1. The **Witness Sampling** (**WS**) Policy is one of the basics of HSF's production and quality control processes.
10.2. *The **WS** policy is actively implemented for all heat treatment processes.*
10.3. *The **WS** quantity is vary depending on the product to be used in the heat treatment processes.*
10.3.1. ***Raw Material Heat Treatment:*** *At least 5 samples taken from different rods, each at least 5 cm (1.9685 inches) in size, depending on the dimensions of the raw material.*
10.3.2. ***Final (Pre-Finish and Pre-Coating) Product Heat Treatments:*** *Selected depending on the product AQL quantity. A special rack is required for product placement and homogeneous air circulation.*
10.3.3. ***Products with Extremely Sensitive Surfaces:*** *Heat treatment processes for these products are permitted only with customer approval. The number of witness samples must be determined by the customer.*
10.4. ***Witness Sample Selection:*** *Unless otherwise specified in the customer or procurement requirements, the Random Sample Selection method is used.*
10.5. ***Witness Sample Data:*** *The following data relating to the control sample should be indicated either by engraving on the sample if it is suitable, or by labeling the sample if it is not suitable:*
10.5.1. *HSF Reference Number,*
10.5.2. *Date,*
10.5.3. *Heat Treatment Process No*
10.5.4. *Raw Material Type and Dimensions*
10.5.5. *Hardness Value – Warehouse (**CH XX.XX HRC**)*
10.5.6. *Hardness Value – Hardening (**HH XX.XX HRC**)*
10.5.7. *Hardness Value – Tempering (**TH XX.XX HRC**)*
10.6. **Photo of the Witness Sample:** Numerically sorted samples are taken photos,

11. KALIBRASYON VE KALIBRASYON DOGRULAMA

TANIMLAR

11.1. **Kalibrasyon:** Uygulanan standard kapsaminda bir ekipman veya sensorun ciktilarinin standard

11. CALIBRATION AND CALIBRATION VERIFICATION

DEFINITIONS

11.1. ***Calibration:*** *An assessment of the accuracy of a sensor or an instrument to a traceable standard sensor*

gereksinimlerini tam karsiladigindan emin olmak icin sensor veya ekipmandan bir veya birden fazla olcum alinarak ve ciktilardaki sapmalarinin potansiyel ayarlamalarinin standarda bagli olarak duzeltilmesi.

11.2. Kesinlik: Uygulanan standardin degerlerinin test edilen ekipman veya sensor icin maksimum sapmasidir.

11.3. Sapma / Hata: Isil islem icin uygulanan gereklilik kapsaminda firinin mevcut sicakligi (**PV**) ile istenen sicakligi (SV) arasindaki farkdir. (Mevcut Sicaklik – Istenen Sicaklik = Sapma (Hata))

11.4. Aralik: Bir kalibrasyon, test veya sensordegisim tarihinden veya gununden (tarih gun dahil dahil) bir sonraki kalibrasyon, test veya sensor degisimin icin sonraki takvim gunu.

11.4.1. Haftalik (Haftada Bir): Her hafta icinde haftanin ayni gunu,

11.4.2. Iki Haftada Bir: Her iki haftada bir haftanin ayni gunu,

11.4.3. Ayda Bir: Her ay icinde ayin ayni gunu

11.4.4. Iki Ayda Bir: Her iki ayda bir, ayin ayni gunu

11.4.5. Uc Ayda Bir (Ceyrek): Her uc ayda bir, ayin ayni gunu

11.4.6. Alta Ayda Bir (Yarim Yil): Her alti ayda bir, ayin ayni gunu

11.4.7. Yillik: Her yil, yilin ayni gunu

11.5. Thermocouple Kalibrasyon Dogrulama: ASTM E220

11.6. Thermocouple Kalibrasyon Dogrulama Zamani: uretici ambalaji acilmadigi surece kullanim oncesi, eger uretici ambalaji kullanim amaci olmadan acilirsa, tekrar ambalajlama oncesi.

11.7. Kalibrasyon Dogrulayici Enstruman Kalibrasyonu: Yillik, ISO17025 izlenebilirligi olan harici laboratuvar.

Kalibrasyon, test veya sensor degisimi icin gun ilgili ay icinde bulunmuyorsa, sonraki kalibrasyon, test veya sensor degisimi icin ayin son takvim gunu kullanilir.

and/or field test or standard instrument, based on one or more measurements, and potentially adjusting an instrument and/or compiling a deviation chart for a sensor or instrument to ensure compliance with requirements.

11.2. Accuracy: *The maximum deviation of the instrument being tested from the values of a traceable standard.*

11.3. Deviation / Error: *In the context of the requirement, the difference between the set temperature (**SV**) and the point temperature (**PV**) (Indicated Temperature - True Temperature = Deviation/Error).*

11.4. Interval: *The calendar days from the day/date a calibration, test, or sensor replacement was performed and the next day/date a calibration, test, or sensor replacement is due (inclusive).*

11.4.1. Week (Weekly): *The same day of the week every week,*

11.4.2. Biweekly: *The same day of the week every 2 weeks,*

11.4.3. Monthly: *The same day of the month every month*

11.4.4. Bimonthly: *The same day of the month every 2 months*

11.4.5. Quarterly: *The same day of the month every 3 months*

11.4.6. Semiannually: *The same day of the month every 6 months*

11.4.7. Annually: *The same day of the year every year*

11.5. Thermocouple Calibration Verification: *ASTM E220*

11.6. Thermocouple Calibration Verification Time: *before use, provided the manufacturer's packaging remains unopened; if the manufacturer's packaging is opened for any purpose other than use, before repackaging.*

11.7. Calibration Verification Instrument Calibration: *Annual, external laboratory with ISO17025 traceability.*

If the next calibration, test, or sensor replacement is due on a calendar date not contained in that month, then the last day of that calendar month shall be used for the next calibration.

12. SUREC KONTROLU

12.1. Isi Kontrolu: HSF bunyesindeki isil islem firinlarinda isil islem surec kontrolu birbirinden bagimsiz olarak calisan 4 (dort) ayri isi control mekanizmasiyla takip edilir ve raporlanir.

12.1.1. Birincisi firinlarin fabrika cikis tam otomatik isi ve surec control paneli.

12.1.2. Ikincisi, firinlarin fabrika cikis manuel isi ve surec control panelleri.

12.1.3. Ucuncusu, load sensor,

12.1.4. Dorduncusu, Pyrometer.

12.2. On Isitma: On isitma surecinde firin en az 1 saatlik bir periyotta ortalama 60 ^{0}C (140 ^{0}F) derecelik bir sicaklikta calistirilir. On isitma surecinde hedeflenen amaclar su sekildedir:

12.2.1. Calistirilacak isil islem programinin degerlendirilmesi,

12.2.2. Firinin genel kosullarinin kontrolu ve firinin stabil sicakliga ulastirilmasi,

12.2.3. Isil islem uygulanacak malzemelerin esit sicaklik seviyesine getirilmesi,

12. PROCESS CONTROL

12.1. Temperature Control: In HSF's heat treatment furnaces, the process is monitored and reported using 4 (four) separate, independently operating temperature and process control mechanisms.

12.1.1. The first, the furnaces' factory-installed fully automatic heat and process control panel.

12.1.2. Secondly, the furnaces' factory-installed manual heat and process control panels.

12.1.3. Thirdly, the load sensors.

12.1.4. Fourthly, the pyrometer.

12.2. Pre-Heating: During the pre-heating process, the oven is operated at an average temperature of 60 ^{0}C (140 ^{0}F) degrees for a period of at least 1 hour. The aims of the pre-heating process are as follows:

12.2.1. Evaluation of the heat treatment program to be run,

12.2.2. Control the general conditions of the furnace and to keep the inside temperature of the furnace in stable,

12.2.3. Bringing the materials to be heat treated to equal temperature levels,

12.2.4. Sistem vakumda calistiriliyorsa, vakum degerlerinde ayar degerleri disinda istenmedik bir degisim var olup olmadigi da kontrol edilir.

12.3. Isitma hizi metaryelde yasanabilecek kusurlar icin onemli bir etkendir. Bu nedenle 704 ^{0}C (1300 ^{0}F) uzerinde uygulanacak isil islem surecleri icin 538 – 649 ^{0}C (1000 – 1200 ^{0}F) derece arasinda on isitma uygulanmasi asagidaki kosullarda tavsiye edilir:

12.3.1. 35 HRC ve uzerine onceden sertlestirilmis,

12.3.2. Yuzde olarak nominal 0.50 veya ustu karbon iceren materyeller,

12.3.3. Keskin acili veya ic ice gecmis acilara sahip yuzeyli malzemeler.

12.4. Isitma Hizi: Isitma hizi metaryelde yasanabilecek kusurlar icin onemli bir etkendir.

Burada Verilen Degerler Celik ve Paslanmaz Celik grubu hammaddeler icin aksi musteri tarafindan belirtilmedigi surece uygulanir. Degerler hammaddenin tipine ve urune bagli olarak degisiklik gosterebilir.

12.4.1. Kutlesel olarak firin ic hacminin yuzde 30'una kadar dolulukta 30mm'e kadar cap cubuklar icin

12.4.1.1. **On Isitma:** 60 Dakika – 60 ^{0}C (140 ^{0}F)

12.4.1.2. **On Isitma → Soak:** 120 Dakika

12.4.1.3. **Soak Suresi:** 120 Dakika

12.4.1.4. **Sogutma:** Polimer (20%)

12.4.1.5. **Hedef:** Sertlestirme

12.4.1.6. **Temperleme: En fazla 4 saat icinde** ortam sicakligina inen urunler herturlu yag, tuz veya dis etkenlerden temizlendikden sonra.

12.4.2. Kutlesel olarak firin ic hacminin yuzde 50'sine kadar dolulukta 60mm'e kadar cap cubuklar icin

12.4.2.1. **On Isitma:** 90 Dakika – 60 ^{0}C (140 ^{0}F)

12.4.2.2. **On Isitma → Soak:** 120 Dakika

12.4.2.3. **Soak Suresi:** 180 Dakika

12.4.2.4. **Sogutma:** Polimer (30%)

12.4.2.5. **Hedef:** Sertlestirme

12.4.2.6. **Temperleme:** En fazla 4 saat icinde ortam sicakligina inen urunler herturlu yag, tuz veya dis etkenlerden temizlendikden sonra.

12.5. Sogutma: HSF, isil islem sogutma surecleri icin Polimer Sogutucu kullanmaktadir.

12.5.1. Polimer sicakligi, sogutma surecinde 60 ile 110 ^{0}F (16 – 43 ^{0}C) arasinda olmalidir.

12.5.2. Polimer sicakligi ureticinin belirledigi maksimum sicaklik degerini asmamalidir.

12.5.3. Polimer tuz oraninin 6%'yi gecmemesi gerekir, bu konuda duzenli takip gerekmektedir.

12.5.4. Isil islem surec formunda polimer sogutucu ile ilgili olarak asagidaki bilgiler belirtilmelidir:

√ uretici adi,
√ marka adi,
√ model adi,
√ batch/seri no,
√ tuz orani,
√ uretim yili,

12.2.4. If the system is settled for the vacuum operating, it is also checked whether there is any undesirable change in the vacuum values other than the setting values.

12.3. Heating rates are important to prevent the damages to be occurred on the material. Pre-heating at 538 to 649 °C (1000 to 1200 °F) is recommended before heating material above 704 °C (1300 °F) if the material has any of the following conditions:

12.3.1. Has been previously hardened above HRC 35,

12.3.2. Is made of steel of 0.50 (nominal) percent carbon or higher,

12.3.3. Has abrupt changes of section, or sharp re-entrant angles.

12.4. Heating Rate: Heating rates are important to prevent the damages to be occurred on the material.

The values given here apply to steel and stainless steel raw materials unless otherwise specified by the customer. Values may vary depending on the type of raw material and the product to be heat-treated.

12.4.1. *For rods with a diameter to the 30mm and filling the oven to 30% of its internal volume by mass,*

12.4.1.1. ***Pre-Heating:*** *60 Minutes - 60 ^{0}C (140 ^{0}F)*

12.4.1.2. ***Pre-Heating → Soak:*** *120 Minutes*

12.4.1.3. ***Soak Time:*** *120 Minutes*

12.4.1.4. ***Quenching:*** *Polymer (20%)*

12.4.1.5. ***Target:*** *Hardening*

12.4.1.6. ***Tempering:*** *Products that have cooled to room temperature within a maximum of 4 hours, after being cleaned of all oils, salts, or external factors.*

12.4.2. *For rods with a diameter to the 60mm and filling the oven to 50% of its internal volume by mass,*

12.4.2.1. ***Pre-Heating:*** *90 Minutes - 60 ^{0}C (140 ^{0}F)*

12.4.2.2. ***Pre-Heating → Soak:*** *120 Minutes*

12.4.2.3. ***Soak Time:*** *120 Minutes*

12.4.2.4. ***Quenching:*** *Polymer (30%)*

12.4.2.5. ***Target:*** *Hardening*

12.4.2.6. ***Tempering:*** *Products that have cooled to room temperature within a maximum of 4 hours, after being cleaned of all oils, salts, or external factors.*

12.5. Quenching: HSF uses Polymer Quenching media for the heat treatment quenching process.

12.5.1. The polymer temperature should be between 60 and 110 °F (16 – 43 °C) during the cooling process.

12.5.2. The temperature of the polymer must not exceed the maximum temperature specified by the manufacturer.

12.5.3. Polymers shall be monitored to ensure salt content does not exceed 6% by weight.

12.5.4. For the polymer, at the heat treatment process form, the following information will be specified:

√ the manufacturer name,
√ brand name,
√ model number,
√ batch/serial number,
√ salt content,
√ manufacturing date,

√ son kullanim tarihi

√ expiry date

13. HIDROJEN GEVREKLIGI

13.1. **Hidrojen Gevrekligi** atomik hidrojenin metallere (ozellikle yuksek mukavemetli celiklere) nufuz etmesi, suneklikleri, tokluklarini ve yuk tasima kapasitelerini azaltmasi ve ani, erken ve bazen de felaketle sonuclanan gevrek kirilmalara yol acmasi surecidir.

13.2. Isil islem sureclerinde yasanabilecek en ciddi sorunlardan biri de Hidrojen Gevrekligidir.

13.3. **Hidrojen Gevrekligi Nedenleri:**

13.3.1. **Sogutma Suresi:** Ozellikle sogutma sureci esnasinda isil islem uygulanan ururun uzun sure sogutma sivisina maruz kalmasi.

13.3.2. **Temperlemeye Gecis Suresi:** Sogutma sureci sonrasi urunlerin temperlemeye gec alinmasi (**bu sure 4 saati gecmemelidir**).

13.3.3. **Temizlik:** Sogutma sureci sonrasi urunlerin temizlenmemesi (**en fazla 2 (iki) saat icinde sogutma sivisi artiklarindan (yag, tuz) temizlenmelidir**).

13. HYDROGEN EMBRITTLEMENT

13.1. ***Hydrogen Embrittlement*** *is the process by which atomic hydrogen penetrates metals (especially high-strength steels), reducing their ductility, toughness, and load-bearing capacity, leading to sudden, premature, and sometimes catastrophic brittle failure.*

13.2. *One of the most serious problems that can occur in heat treatment processes is hydrogen embrittlement.*

13.3. ***Causes of Hydrogen Embrittlement:***

13.3.1. ***Quenching Time:*** *Specifically, the prolonged exposure of the heat-treated product to the quenching fluid during the cooling process.*

13.3.2. ***Tempering Transition Time:*** *The products should be transferred to tempering after the cooling process (**this period should not exceed 4 hours**).*

13.3.3. ***Cleaning:*** *Failure to clean products after the cooling process (**coolant fluid residues (oil, salt) must be removed within a maximum of 2 (two) hours**).*

14. SOGUTMA SIVISI VE SOGUTMA TANKI

14.1.1. **Sogutma Sivisi Tanki:** HSF bunyesinde kullanilan sogutma sivisi tanki genel ozellikleri asagidaki gibidir:

14.1.1.1. Tam hava akiskanligi saglayabilen,

14.1.1.2. Yaklasik 1000 ml sivi kapasiteli,

14.1.1.3. Su/Polymer dengesi icin olcum sistemi,

14.1.1.4. 7 x 24 sicaklik kontrollu.

14.1.2. **Sogutma Methodu:** PAG Polymer (Formaldehit ve Bor Icermez), COO USA

14.1.3. **Polymer Vizkozit Orani:** Kinematik Viskozite @ 40°C (cSt): 300

14.1.4. **Su/Polymer Oran Kontrolu:** Gunluk

14.1.5. **Berraklik ve Artik Kontrolu:** Gunluk, isil islem muhendisi sogutma sivisindaki artiklarin mevcut isil isleme olumsuz etkisi olacagini dusunmesi durumunda sogutma sivisi degisimi uygulanir.

14. COOLANT AND COOLANT TANK

14.1.1. ***Coolant Tank:*** *The general characteristics of the coolant tank used within HSF are as follows:*

14.1.1.1. *Complete fresh-air flow system,*

14.1.1.2. *Approximately 1000 ml liquid capacity,*

14.1.1.3. *Measurement system for polymer/water,*

14.1.1.4. *7 x 24 temperature controller.*

14.1.2. ***Quenching Method:*** *PAG Polymer (Formaldehyde and Boron Free), COO USA*

14.1.3. ***Polymer Balancing:*** *Kinematic Viscosity @ 40°C (cSt): 300*

14.1.4. ***Water/Polymer Balance Control:*** *Daily*

14.1.5. ***Clarity and Residue Control:*** *Daily, if the heat treatment engineer believes that residues in the coolant will negatively affect the ongoing heat treatment, a coolant change is performed.*

15. RISKLER VE TEDBIRLER

15.1. **ELEKTRIK KESINTISI:** Isil islem sureclerinde yasanabilecek en ciddi sorunlardan biri surec icinde elektrik kesintisinin yasanmasidir. Bu durumda asagidaki adimlar izlenir:

15.1.1. **Risk Degeri:** Olasilik (3 Ayda Bir) x Siddet (Yuksek) = Medium (Onleyici Tedbirler).

15.1.2. **Firin Kapaklari:** Program iptal edilmedigi surece hicbir kosulda acilmaz.

15.1.3. **Mevcut Sicakligin 10%'nun Daha Fazla Degisirse:** Sicaklik 200 ^{0}C (392 ^{0}F)'nin altinda yasanirsa program devam eder.

15. RISKS AND PRECAUTIONS

15.1. ***POWER OUTAGE:*** *One of the most serious problems that can occur during heat treatment processing is a power outage problem. In this case, the following steps are followed:*

15.1.1. ***Risk Value:*** *Likelihood (Quarterly) x Severity (High) = Medium (Preventive Actions).*

15.1.2. ***Furnace Doors:*** *Under no circumstances should they be opened unless the program has been canceled.*

15.1.3. ***If the current temperature changes by more than 10%:*** *If the temperature is below 200°C (392°F), the program will continue.*

15.1.4. 200 ^{0}C (392 ^{0}F) Usunde yasanan Kesintilerde: Program iptal edilir ve surec icin musteri onayina ihtiyac duyulur.

15.1.5. Onleyici Tedbirler:

15.1.5.1. Elektrik kesinti takvimi duzenli takip edilmeli, firin elektrik kesintisi yasanma duyurusuna gore gun ve saatde calistirilmamali.

15.1.5.2. Kontrolsuz ve duzenli elektrik kesintileri yasanmasi durumunda fabrika elektrigine gore uygun guc kaynagi tedarigi yapilmali.

15.2. HAMMADDE ETIKETLERININ KARISMASI: Isil isleme girecek tum hammaddelerin is emrine uygun olarak etiketlenmesi esasdir.

15.2.1. Risk Degeri: Olasilik (Alti Ayda Bir) x Siddet (Cok Yuksek) = Medium – (Onleyici Tedbirler).

15.2.2. Onleyici Tedbirler:

15.2.2.1. **Etiket Kontrolu:** Isil isleme girecek urunlerin etiket kontrolu hem isil islem muhendisi hem de isil islem operatoru sorumluluguna verilmeli,

15.2.2.2. **Is Disiplini:** Isil islem surecleri icin her risk faktoru cok ciddi derecede dikkate alinmasi gerekmektedir. Hammadde etiketleme disiplini tum personele yerlestirilmeli ve bu konuda sozlu hatirlatmalar ve egitimler uygulanmali.

15.3. YANLIS PROGRAM:

15.3.1. Risk Degeri: Olasilik (Asla Yasanmaz) x Siddet (Yuksek) = Dusuk (Cevreleyici Tedbirler).

15.3.2. Cevreleyici Onlemler:

15.3.2.1. **Isil Islem Firini Kontrol Paneli:** Kontrol paneli kullanimi sadece yetkili ve atanmis muhendis kontrolunde olmali.

15.3.2.2. **Is Disiplini:** Isil islem surecleri icin her risk faktoru cok ciddi derecede dikkate alinmasi gerekmektedir. Kontrol paneli kullanim disiplini tum personele yerlestirilmeli ve bu konuda sozlu hatirlatmalar ve egitimler uygulanmali.

15.4. YALNIS SOGUTMA METHODU:

15.4.1. HSF bunyesinde isil islem sogutma methodu Polimer, Hava Sogutma ve/veya Firin Ici Sogutma methodlaridir.

15.4.2. HSF gazli sogutma, tuz banyosu, su ve benzeri sogutma yontemleri uygulamaz.

15.4.3. Risk Degeri: Olasilik (Asla Yasanmaz) x Siddet (Medium) = Dusuk.

15.5. HIDROJEN GEVREKLIGI

15.5.1. Hidrojen gevrekligi ozellikle isil islem sureclerinde gaz, polimer veya su ile sogutma uygulanmasi esnasinda olusabilecek cok ciddi bir risk faktorudur.

15.5.2. HSF, **Hidrojen Gevrekligi** surecini **AMS2759/9** standardina gore yurutmektedir ve hidrojen gevrekligi **HSF Korozyon Onleme Politikasi**nin aktif uygulanan bir parcasidir.

15.5.3. HSF Hidrijen Gevrekligi egitim dokumaninin incelenmesi tavsiye edilir.

15.5.4. Risk Degeri: Olasilik (Alti Ayda Bir) x Siddet (Cok Yuksek) = Medium (Onleyici Tedbirler).

15.1.4. In case of the power outage at over 200°C (392°F): *the program is canceled, and customer approval is required.*

15.1.5. Preventive Actions:

15.1.5.1. *The power outage schedule should be regularly monitored, and the furnace program shall be managed in accordance with the announcements.*

15.1.5.2. *If the power outages continued regularly, an appropriate power supply should be provided to meet the factory's electricity needs.*

15.2. MIXING THE RAW MATERIAL LABELS: *It is essential that all raw materials to be subjected to heat treatment are labeled in accordance with the work order.*

15.2.1. Risk Value: *Likelihood (Semi-Annual) x Severity (Very High) = High – (Preventive Actions)*

15.2.2. Preventive Actions:

15.2.2.1. ***Label Control:*** *Responsibility for checking product labels must be assigned to both the heat treatment engineer and the heat treatment operator.*

15.2.2.2. ***Work Discipline:*** *Every risk factor must be taken very seriously in heat treatment processes. Raw material labeling discipline should be instilled in all personnel, and verbal reminders and training should be provided on this matter.*

15.3. WRONG PROGRAM:

15.3.1. Risk Value: *Likelihood (Never) x Severity (High) = Low (Containment Actions)*

15.3.2. Containment Actions:

15.3.2.1. ***Heat Treatment Control Panel:*** *Access to the control panel should only be granted to authorized and assigned engineer.*

15.3.2.2. ***Work Discipline:*** *Every risk factor must be taken very seriously in heat treatment processes. Control panel usage discipline should be instilled in all personnel, and verbal reminders and training should be provided on this matter.*

15.4. WRONG COOLANT METHOD:

15.4.1. *The heat treatment coolant methods within HSF are Polymer, Air Cooling, and/or Furnace Cooling methods.*

15.4.2. *HSF does not use gas cooling, salt bath, water, or similar cooling methods.*

15.4.3. Risk Value: *Likelihood (Never) x Severity (Medium) = Low*

15.5. HYDROGEN EMBRITTLEMENT

15.5.1. *Hydrogen embrittlement is a very serious risk factor that may occur, especially during heat treatment hardening, when cooling with gas, polymer, or water.*

15.5.2. *HSF conducts the hydrogen embrittlement process according to the **AMS2759/9** standard and hydrogen embrittlement is an actively implemented part of **HSF Corrosion Prevention Policy**.*

15.5.3. *Reviewing the HSF Hydrogen Embrittlement training document is recommended.*

15.5.4. Risk Value: *Likelihood (Semi-Annual) x Severity (Very High) = Medium (Preventive Actions)*

15.5.5. Onleyici Tedbirler:

15.5.5.1. **4 Saat Kurali:** isil islem sertlestirme surecleri sonrasi en fazla 4 saat icinde sogutma saglanmali ve urunler tempere alinmali.

15.5.5.2. **Yag (Polimer) veya Tuz Banyosu Kalintilarinin Temizlenmemesi:** Sertlestirme sureci sonrasinda urunlerin temizlenmeden tempere alinmamali.

15.5.5.3. **Is Disiplini:** 12.5.5.1. ve 12.5.5.2. maddeleri tavsiye olarak degil zorunlu tedbir olarak uygulanmali, aksi davranislar icin sirket ici egitim uygulanmali. Bu konuda disiplinsizlik devami olursa gorev degisikligi uygulanmali.

15.6. YENIDEN ISIL ISLEM (Reheat)

15.6.1. Yeniden isil islem sureci sadece musteri onayi ile uygulanir.

15.6.2. Risk Degeri: Olasilik (3 Ayda Bir) x Siddet (Yuksek) = Medium (Onleyici Tedbirler).

15.6.3. Onleyici Tedbirler:

15.6.3.1. **Sahit Numune:** tum isil islem surecleri icin mutlaka sahit numune uygulanmali (madde 8'e bakin),

15.6.3.2. **Musteri Onayi:** ister hammadde kaynakli isterse HSF ici bir nedene (ornegin elektrik kesintisi) bagli olarak isil islem surecinde basarisizlik olmasi durumunda musteri onayi istenmesi zorunludur.

15.7. YAGLI VEYA KAPLAMALI URUNLER

15.7.1. HSF QCPA politikasina gore isil isleme girecek her urunun firin yerlesimi oncesi temizlenmesi on kosuldur. Bu husus isil islem is emri formununda bir parcasini olusturur.

15.7.2. Risk Degeri: Olasilik (Asla Yasanmaz) x Siddet (Yuksek) = Dusuk (Cevreleyici Tedbirler).

15.7.3. Cevreleyici Tedbirler: HSF isil islem surecleri oncesi asagidaki controller yapilir:

15.7.3.1. urunlerin yagdan temizlenmesi,

15.7.3.2. urunlerin uzerinde etiket gibi yabanci cisimlerin olmasi,

urunlerin kaplama veya benzeri islem gormemis olmasi

15.8. URUN YERLESIMINE DIKKAT EDILMEMESI

15.8.1. Urun yerlesimi isil islem surecleri icin hem is guvenligi hem de urun guvenligi acisindan en onemli konulardan biridir.

15.8.2. Risk Degeri: Olasilik (3 Ayda Bir) x Siddet (Yuksek) = Medium (Onleyici Tedbirler).

15.8.3. Onleyici Tedbirler:

15.8.3.1. Hava Sirkulasyonu (**8.5.**), Isiticilara Temas (**8.6.**) ve Merkezleme (**8.7**) kurallarina ekstra dikkat edilmeli.

15.8.3.2. Isil islem sureci baslamadan once hem operator hemde muhendis kontrolu sartdir.

15.9. RAFLAMAYA DIKKAT EDILMEMESI

Raflama (veya sepetleme) urun agirliginin ve tasina bilirligi konusunda dikkat edilmesi gereken onemli noktalardir.

15.9.1. Risk Degeri: Olasilik (3 Ayda Bir) x Siddet (Yuksek) = Medium (Onleyici Tedbirler).

15.5.5. Preventive Actions:

15.5.5.1. ***4-Hour Rule:*** *After heat treatment and hardening, cooling must be completed within 4 hours, and the products should be tempered.*

15.5.5.2. ***Failure to Clean the Remains After Oil (Polymer) or Salt Bath:*** *Products should not be tempered without cleaning them after the hardening process.*

15.5.5.3. ***Work Discipline:*** *Clauses 12.5.5.1 and 12.5.5.2 should be implemented as coercive measures, not just recommendations; internal training should be provided for non-compliant behavior. If indiscipline continues, a change of duties should be implemented.*

15.6. REHEAT TREATMENT PROCESS

15.6.1. *The re-heat treatment process is only applied with customer approval.*

15.6.2. Risk Value: *Likelihood (Quarterly) x Severity (High) = Medium (Preventive Actions)*

15.6.3. Preventive Actions

15.6.3.1. ***Witness Sample:*** *A witness sample must be used for all heat treatment processes (see clause 8).*

15.6.3.2. ***Customer Approval:*** *In the event of a failure in the heat treatment process, whether due to raw material issues or internal HSF reasons (e.g., power outage), customer approval is mandatory.*

15.7. OILY OR COATED PRODUCTS

15.7.1. *According to the HSF QCPA policy, cleaning each product before the furnace placement stage is a prerequisite for heat treatment. This is part of the heat treatment work order form.*

15.7.2. Risk Value: *Likelihood (Never) x Severity (High) = Low (Containment Actions)*

15.7.3. Containment Actions: *Before a heat treatment process, the following checks are performed:*

15.7.3.1. *products are cleaned of oil,*

15.7.3.2. *products are free of foreign objects such as stickers,*

products have not undergone coating or similar processing.

15.8. LACK OF ATTENTION TO PRODUCT PLACEMENT

15.8.1. *Product placement is one of the most important subjects of heat treatment processes, both in terms of occupational safety and product safety.*

15.8.2. Risk Value: *Likelihood (Quarterly) x Severity (High) = Medium (Preventive Actions)*

15.8.3. Preventive Actions

15.8.3.1. *Pay extra attention to the subjects of the Air Circulation (**8.5.**), Contact with Heaters (**8.6.**) and Centering (**8.7.**).*

15.8.3.2. *It is mandatory point double check before heat treatment process by the operator and the engineer.*

15.9. FAILURE TO RACKING

Racking (or basketing) is an important consideration regarding product weight and carrying.

15.9.1. Risk Value: *Likelihood (Quarterly) x Severity (High) = Medium (Preventive Actions)*

15.9.2. Onleyici Tedbirler

15.9.2.1. Isil isleme girmeden once raflama (veya sepetleme) uygulanacaksa tum urunler mutlaka firin disinda raflanmali (veya sepetlenmeli) ve yasanabilecek sorunlara gore urun yerlesimi yapilmalidir.

15.9.2.2. Isil islem sureci baslamadan once hem operator hemde muhendis kontrolu sartdir.

15.9.2. Preventive Actions

15.9.2.1. *If racking (or basketing) is to be applied, all products must be racked (or basketed) outside the furnace before heat treatment process, and product placement should be arranged to address potential problems.*

15.9.2.2. *It is mandatory point double check before heat treatment process by the operator and the engineer.*

16. KALITE KONTROL

16.1. Isil islem sureclerinin dogrulanmasi ve onaylanmasi kapsaminda HSF bunyesinde asagidaki testler uygulanabilmektedir:

16.1.1. Cekme – Kopma Dayanimi,
16.1.2. Sertlik Kontrolu – Rockwell,
16.1.3. Sertlik Kontrolu – Micro Vickers,
16.1.4. Darbe Testi,
16.1.5. Metallurgic Inceleme
16.1.6. Conductivity (Eddy Current) Iletkenlik Testi (uygun hammaddeler icin)
16.1.7. Viscosite Akiskanlik Testi (Sogutma tanki su/polymer dengesi icin),
16.1.8. Metalografi inceleme (Tane Boyutu, Tane Yapisi, Faz Yapi Analizi, mikro hata inceleme gibi)

HSF bunyesinde uygulanan tum kalite control testlerinin raporlanmasi esasdir.

Isil islem surecleri icin uygulanan testler, isil islem muhendisinden farkli muhendislerce uygulanmasi esasdir.

16. QUALITY CONTROL

16.1. *In the scope of verifying and approving the heat treatment process, the following tests can be applied within HSF:*

16.1.1. *Tensile Strength,*
16.1.2. *Hardness Test – Rockwell,*
16.1.3. *Hardness Test – Micro Vickers,*
16.1.4. *Impact Test,*
16.1.5. *Metallurgical Inspection,*
16.1.6. *Conductivity (Eddy Current) Test (for equivalent raw materials),*
16.1.7. *Viscosity Test (for water/polymer balance in the coolant tank),*
16.1.8. *Metallography inspections (grain size and shape, decarburization, micro defect analysis)*

Reporting of all quality control tests performed within HSF is essential.

Tests applied to heat treatment processes should be performed by engineers other than the heat treatment engineer.

17. EGITIM VE DEGERLENDIRME

17.1. HSF sirket ici egitim ve sertifikasyon surecleri ERP sistemi uzerinden yurutulmektedir.

17.2. Isil islem egitim konulari SAE ARP1962 (Training and Approval of Heat-Treating Personnel) dokumani gore belirlenmisdir.

17.3. Bu egitimler tum personele acikdir fakat isil islem muhendisi olarak atanabilmek icin bu egitimlerin basariyla tamamlanmasi ve sertifikalanma esasdir.

17.4. Isil islem muhendisi icin surec egitiminin yillik olarak yenilenmesi zorunlulugu vardir.

17. TRAINING AND QUALIFICATION

17.1. *HSF's internal training and certification processes are managed through the ERP system.*

17.2. *Heat treatment training topics are determined in accordance with the SAE ARP1962 (Training and Approval of Heat-Treating Personnel) document.*

17.3. *These trainings are open to all personnel, but successful completion of these trainings and certification are essential for appointment as a heat treatment engineer.*

17.4. *Annual renewal of process training is mandatory for heat treatment engineers.*