

# FIRST ARTICLE INSPECTION REPORT

(CUSTOMER APPROVAL)

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Revision: 0  
Date: 05 October 2005

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TITLE: INSPECTION REPORT FOR KN3849, KN3850, KN3851 & KN3852 –  
SCORE ENERGY MANUFACTURED AVON SINGLE DISH FLAME TUBES, POSITIONS 1 TO 8

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0	05/10/2005	First Issue	Sam O'Leary	IAW FAIR-KN3849-52	Andrew Bailey
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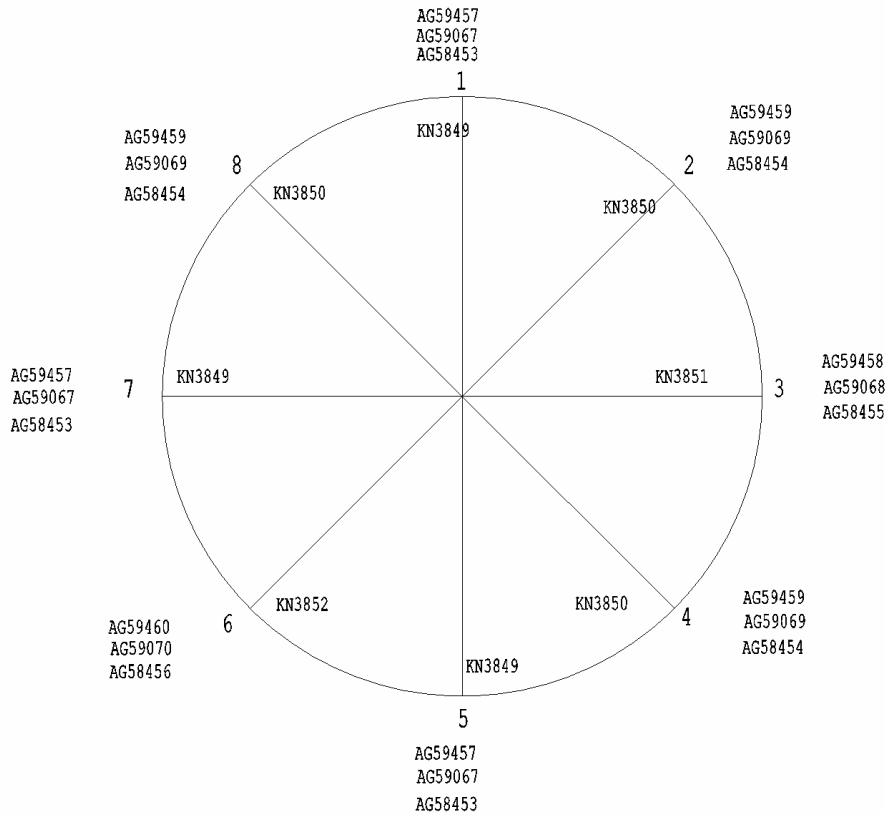
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## 1. Relationship to OEM Component

The Score Energy manufactured Avon single dish flame tubes are equivalent to OEM manufactured Avon single dish flame tubes at modification standard 4601.

**Figure 1.1.** Drawing showing relationship / equivalent modification standard between Score Energy manufactured single dish flame tube and OEM single dish flame tube.



## 2. Materials of Construction

Note: Image sizes are for representation only and are not to scale

**Table 2.1. - Component detail, material specifications.**

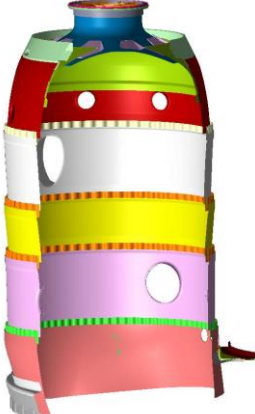


Item Number	Description	Image	Quantity	Material Specification	Material Form
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KN3849 KN3850 KN3851 KN3852	Single Dish Flame Tube Assembly		3 3 1 1	Nimonic 75 18/8 Cr – Ni Stainless Steel	Sheet / Bar
Assemblies KN3849, KN3850, KN3851 & KN3852 are assembled from the detail components as listed below					
KND001	Centre Fitting		1	18/8 Cr – Ni Stainless Steel	Bar
KND002	Spacer Bracket		9	Nimonic 75	Sheet 18 SWG


Item Number	Description	Image	Quantity	Material Specification	Material Form
KND003	Fitting		1	18/8 Cr – Ni Stainless Steel	Bar

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KND004	Fitting		1	18/8 Cr – Ni Stainless Steel	Bar
KND005	Fitting		1	Nimonic 75	Sheet 18 SWG
KND006	Spacer		1	Nimonic 75	Sheet 20 SWG


Item Number	Description	Image	Quantity	Material Specification	Material Form
KND007 KND008	Skin Flange		1 1	Nimonic 75 Nimonic 75	Sheet 20 SWG

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KND009	Flange		1	18/8 Cr – Ni Stainless Steel	Bar
KND010	Skin		1	Nimonic 75	Sheet 20 SWG
KND011	Corrugated Baffle		1	Nimonic 75	Sheet 20 SWG

Item Number	Description	Image	Quantity	Material Specification	Material Form
KND012 and KND024 KND025 or KND026 KND033	Skin  Elliptical Port Elliptical Port  Elliptical Port Elliptical Port		1 and 1 1 or 1 1	Nimonic 75  Nimonic 75 Nimonic 75  Nimonic 75 Nimonic 75	Sheet 20 SWG

Notes: KND024 & KND025 are male locations and are used only on assemblies KN3850 & KN3852  
 KND026 & KND033 are female locations and are only used on assemblies KN3849 & KN3851

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KND013	Corrugated Baffle		2	Nimonic 75	Sheet 20 SWG
KND014	Skin		1	Nimonic 75	Sheet 20 SWG
KND015	Skin		1	Nimonic 75	Sheet 20 SWG
Item Number	Description	Image	Quantity	Material Specification	Material Form
KND016	Corrugated Baffle		1	Nimonic 75	Sheet 18 SWG
KND017	End Skin		1	Nimonic 75	Sheet 18 SWG




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KND018	Stiffener		1	Nimonic 75	Sheet 18 SWG
KND019	Stiffener		1	18/8 Cr – Ni Stainless Steel	Sheet 18 SWG

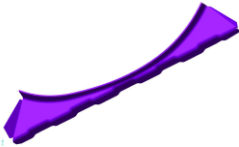
Item Number	Description	Image	Quantity	Material Specification	Material Form
KND020	Stiffener		1	Nimonic 75	Sheet 18 SWG
KND021	Stiffening Bracket		2	Nimonic 75	Sheet 18 SWG
KND022 KND023	Stiffening Bracket Stiffening Bracket		1 1	Nimonic 75 Nimonic 75	Sheet 18 SWG

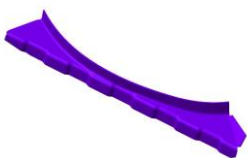


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KND027	Corrugated Stiffener		1	Nimonic 75	Sheet 18 SWG
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Item Number	Description	Image	Quantity	Material Specification	Material Form
KND028	Corrugated Stiffener		1	Nimonic 75	Sheet 18 SWG
KND029	Stiffening Bracket		2	Nimonic 75	Sheet 18 SWG
KND030 KND031	Corner Plate Left Corner Plate Right		1 1	Nimonic 75 Nimonic 75	Sheet 18 SWG



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KND032	Sealing Ring		1	18/8 Cr – Ni Stainless Steel	Bar
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### 3. Chemical Composition

**3.1. Items manufactured from Nimonic 75** (Refer to table 2.1).  
Conforming to OEM specification MSRR 7104 or approved equivalent.

Constituent	Value (wt %) unless otherwise stated
C	0.08 to 0.15
Si	≤1.0
Mn	≤1.0
S	≤200 ppm
Co	≤5.0
Cr	18.0 to 21.0
Cu	≤0.5
Fe	≤5.0
Pb	≤50 ppm
Ti	0.20 to 0.60
Ni	REMAINDER

**3.2. Items manufactured from 18/8 Cr – Ni Stainless Steel Bar** (Refer to table 2.1).  
Conforming to OEM specification MSRR 6522 or approved equivalent.

Constituent	Value (wt %) unless otherwise stated
C	≤0.08
Si	0.20 to 1.0
Mn	0.5 to 2.0
P	≤0.035
S	≤0.025
Al	≤0.05
Cr	17.0 to 19.0
Cu	≤0.5
Mo	≤1.0
Ni	7.0 to 11.0
Nb	≤1.1 (minimum value =

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	10 x C content)
Fe	REMAINDER

**3.3. Items manufactured from 18/8 Cr – Ni Stainless Steel Sheet** (Refer to table 2.1).  
Conforming to OEM specification MSRR 6523 or approved equivalent.

Constituent	Value (wt %) unless otherwise stated
C	≤0.08
Si	0.20 to 1.0
Mn	0.5 to 2.0
P	≤0.035
S	≤0.025
Al	≤0.05
Cr	17.0 to 19.0
Mo	≤1.0
Ni	7.0 to 11.0
Nb	≤1.0 (minimum value = 10 x C content)
Fe	REMAINDER

## **4. Heat Treatment (as supplied)**

**4.1. Items manufactured from Nimonic 75** (Refer to table 2.1).  
Conforming to OEM specification MSRR 7104 or approved equivalent.

Annealed at 1000 to 1100°C followed by air cooling or other suitable medium.

**4.2. Items manufactured from 18/8 Cr – Ni Stainless Steel Bar** (Refer to table 2.1).  
Conforming to OEM specification MSRR 6522 or approved equivalent.

Softened at 1050 to 1080°C followed by air cooling, oil quenching or water quenching.

**4.3. Items manufactured from 18/8 Cr – Ni Stainless Steel Sheet** (Refer to table 2.1).  
Conforming to OEM specification MSRR 6523 or approved equivalent.

Softened at 1000 to 1100°C followed by air cooling, oil quenching or water quenching.

## **5. Mechanical Properties**

**5.1. Items manufactured from Nimonic 75** (Refer to table 2.1).  
Conforming to OEM specification MSRR 7104 or approved equivalent.

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0.2% Proof Stress (Tension)			UTS (Tension)			Ductility (% Elongation)		
Temp °C	Result	Unit	Temp °C	Result	Unit	Temp °C	Result (%)	Gauge Length (mm)
20	≥310	MPa	20	≥760	MPa	20	≥30	50

**5.2. Items manufactured from 18/8 Cr – Ni Stainless Steel Bar** (Refer to table 2.1).  
 Conforming to OEM specification MSRR 6522 or approved equivalent.

For component details KND001, KND003, KND004 & KND032 (Refer to table 2.1).

0.2% Proof Stress (Tension)			UTS (Tension)			Ductility (% Elongation)		
Temp °C	Result	Unit	Temp °C	Result	Unit	Temp °C	Result (%)	Gauge Length Root (A)
20	≥210	MPa	20	≥540	MPa	20	≥35	5.65

Hardness	
Test Type	Result
Brinell	140 to 220
Vickers	150 to 230

For component detail KND009 (Refer to table 2.1).

0.2% Proof Stress (Tension)			UTS (Tension)			Ductility (% Elongation)		
Temp °C	Result	Unit	Temp °C	Result	Unit	Temp °C	Result (%)	Gauge Length Root (A)
20	≥210	MPa	20	≥540	MPa	20	≥30	5.65

Hardness	
Test Type	Result
Brinell	140 to 220
Vickers	150 to 230

**5.3. Items manufactured from 18/8 Cr – Ni Stainless Steel Sheet** (Refer to table 2.1).  
 Conforming to OEM specification MSRR 6523 or approved equivalent.

0.2% Proof Stress (Tension)			UTS (Tension)			Ductility (% Elongation)		
Temp °C	Result	Unit	Temp °C	Result	Unit	Temp °C	Result (%)	Gauge Length Root (A)
20	≥210	MPa	20	≥540	MPa	20	≥30	5.65

Hardness	
Test Type	Result
Vickers	≤220

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## **6. Tungsten Inert Gas Welding**

### **6.1. Welding Rod:**

Welding wire used for joining of:

- Nimonic 75 to Nimonic 75
- Nimonic 75 to 18/8 Cr – Ni Stainless Steel

NC 80/20 conforming to OEM specification MSRR 9500/3.

Constituent	Value (wt %) unless otherwise stated
C	0.26 max
Si	0.50 max
Mn	1.20 max
P	0.03 max
S	0.015 max
Cr	18.0 to 21.0
Cu	0.20 max
Fe	0.5 max
Ni	REMAINDER

### **6.1. Welding Rod (continued)**

Welding wire used for joining of:

- 18/8 Cr – Ni Stainless Steel to 18/8 Cr – Ni Stainless Steel

18/8 Stainless conforming to OEM specification MSRR 9500/2.

Constituent	Value (wt %) unless otherwise stated
C	0.08 max
Si	0.25 to 0.65
Mn	1.0 to 2.5
P	0.03 max
S	0.03 max
Cr	19.0 to 21.5
Mo	0.5 max
Ni	9.0 to 11.0
Cu	0.5 max
Nb	10×C content (1.0 max)

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Fe	REMAINDER
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### 6.2 Welder Approval:

Operator approved IAW OEM test schedule RPS 912 Issue 10.

*Please turn over*

## **7. Resistance Welding:**

### **7.1 Resistance welding is used to join the following:**

Stitch welding of components (refer to table 2.1):

KND001, KND002, KND005, KND006, KND007, KND008 KND017, KND018, KND019, KND020, KND021, KND022, KND023, KND027, KND028, KND029, KND030, KND031.

Spot welding of components (refer to table 2.1):

KND010, KND011, KND012, KND013, KND014, KND015, KND016, KND017.

### **7.2 Resistance Welding Electrodes**

In all cases Mallory 328, 16mm diameter electrodes are used

### **7.3 Resistance Welding Integrity**

Post resistance welding qualification is conducted for each batch IAW BS EN 15614-12: 2004

## **8. Assembled Heat Treatment**

As condition of supply.

## **9. Non Destructive Testing**

Non Destructive Testing (NDT) is conducted at all stages of manufacture.

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All detail components are subject to 100% penetrant flaw detection prior to assembly.  
Assembled component is subject to further penetrant flaw detection.  
All conducted IAW BS M39 & BS EN4179:2005

*please turn over*

### **10. Tungsten Carbide Coating**

#### **10.1 Reason for application:**

The contact surfaces of the flame tube to snout location, and side / outer baffles are given a coating of tungsten carbide coating in order to extend overhaul life by improving resistance to wear of the contact / mating surfaces.

#### **10.2. Areas to be coated:**



Intake snout location flange bore



Baffle strips, inside & outside faces coated

#### **10.3. Coating to be applied:**

Praxair 1343 VM

Nominal composition:

Tungsten carbide: 83%  
Cobalt: 17%

#### **10.4. Coating Properties:**

Bond Strength: 10,000 psi  
Micro-Hardness: 1,125 HV<sub>300</sub>  
Microstructure: Porosity ~ 2%  
Oxides ~ 2%

#### **10.5. Method of application:**

Robot manipulated High Velocity Oxygen Fuelled (HVOF)

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### **11. Dimensional Report**

All components inspected by a combination of computer controlled & conventional measuring techniques to ensure compliance to manufacturing drawings KN3849, KN3850, KN3851 & KN3852.

### **12. Functionality Testing**

In order to verify the dimensional data recorded in section 11 of this report a trial engine build was conducted using a complete engine set of Score Energy manufactured single dish flame tubes. The flame tubes were assembled fully IAW the RR assembly instructions and found to be satisfactory. All parts used in the trial engine build were (with the exception of the single dish flame tube) either new, serviceable or overhauled OEM components.

\*\*\*\*\*end of report\*\*\*\*\*