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Design of Experiment for Irradiation of Welded Candidate Fe-Cr-Al Alloys

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July 31, 2015

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OAK RIDGE NATIONAL LABORATORY
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Nuclear Energy Enabling Technologies (NEET): Reactor Materials Effort

Design of Experiment for Irradiation of Welded Candidate Fe-Cr-Al Alloys

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1. OBJECTIVES

The objective of the irradiation campaign described within is to provide critical data on the radiation response of candidate Fe-Cr-Al alloys designed to have enhanced weldability and radiation tolerance. This objective will be met by using a specialized irradiation capsule to be inserted into Oak Ridge National Laboratory's High Flux Isotope Reactor (HFIR) followed by extensive post irradiation examination (PIE) including mechanical testing and microstructural characterization. Several different irradiation temperatures and doses will be investigated to establish temperature/dose relationships on specific radiation-induced and/or radiation-enhanced mechanisms within the candidate Fe-Cr-Al alloys. Data and analysis as the result of these efforts will enable informed decisions on the future use of Fe-Cr-Al alloys for a wide range of nuclear power generation applications including fission and fusion based reactor applications.

2. INTRODUCTION

Fe-Cr-Al alloys are an attractive class of materials for nuclear power production applications due to their excellent environmental compatibility including aqueous corrosion, Pb-Li compatibility, and high temperature steam oxidation [1, 2]. Furthermore, Fe-Cr-Al alloys have seen use in other energy generation and industrial applications including the fossil fuel and automotive industry. The use within these industries provides a foundation in which to establish materials development efforts of Fe-Cr-Al alloys for nuclear environments. One issue of primary concern for nuclear applications is the ability to successfully join parts through fusion-based welding and/or solid-state welding technologies. Research in non-nuclear industries indicates that Fe-Cr-Al alloys are susceptible to cracking using fusion-based welded technologies [3-5]. In particular, studies such as the one conducted by Dupont *et al.* indicate that hydrogen impurities can lead to significant cracking in specific Fe-Cr-Al alloy compositions [6]. Such cracking during joining would limit the application of Fe-Cr-Al alloys for nuclear applications.

Another mater of concern for joining of Fe-Cr-Al alloys is the radiation tolerance in typical radiation environments for nuclear power production. Fusion based welding technologies can lead to microstructures that are vastly different from the microstructures seen in the base material. It is well known that microstructural features such as grain size, dislocation density, and precipitate density/size can greatly impact the radiation tolerance of a material [7]. The loss of controlled microstructure through fusion-based welding could compound with the detrimental formation of the Cr-rich α' phase that has been shown to occur in specific Fe-Cr-Al alloy compositions during neutron irradiation [8]. Such limited radiation tolerance within the fusion zone of a weldment could lead to significant radiation-induced hardening and embrittlement leading to possible cracking of an in-service part. Embrittlement and cracking of a weldment during operation in a commercial nuclear power plant is unacceptable.

Currently, no systematic investigations have been conducted to assess the weldability and radiation tolerance of controlled fusion welds in the Fe-Cr-Al alloy class. Such lack of data and analysis limits the ability to draw conclusions on the performance of welded Fe-Cr-Al alloys for nuclear power generation applications. To fill this knowledge gap and establish baseline properties of welded Fe-Cr-Al alloys for nuclear applications, a research and development program centralized on the use of candidate Fe-Cr-Al alloys, fusion based welding techniques, and irradiation campaigns using the High Flux Isotope Reactor (HFIR) has been established.

The program is centralized on two specific mitigation strategies for joining and/or radiation-induced hardening and embrittlement of Fe-Cr-Al weldments. The first is the use of hydrogen trapping sites to limit cracking resulting from the fusion-based welding process. The second is the use of Fe-Cr-Al alloys with Al contents above 5 wt.% to limit the precipitation of the Cr-rich α' phase during service. Both of these mitigation strategies could have compounding effects leading to significantly reduced chances of failure of a Fe-Cr-Al made part during service due to material based issues. Both of these candidate Fe-Cr-Al alloy types have been fabricated as part of the program with highlights on the processing routes reported previously [9].

To investigate the capability of these candidate Fe-Cr-Al alloys, controlled laser-based welding has been conducted. These weldments are currently undergoing extensive microstructural characterization to determine the weldability of the candidate alloys. Of the upmost importance, is the investigation on the radiation tolerance of both welded and non-welded variants of the candidate Fe-Cr-Al alloys. Therefore, a large-scale irradiation campaign centralized on evaluating the radiation tolerance of the alloys at varying conditions has been conceptualized, designed, and fabricated. The following report highlights the activities centered on the alloys for investigation, the design of experiment, and capsule fabrication for the HFIR-based irradiation program.

3. CANDIDATE Fe-Cr-Al ALLOYS

3.1.1 Materials

The alloys for investigation are those fabricated and reported on previously [9]. To summarize, seven Fe-Cr-Al alloy variants have been fabricated from a base Fe-13Cr-5Al-2Mo-0.2Si-0.05Y alloy. The nominal compositions of these alloys and their designations can be found in Table 1. The compositions determined by an outside vendor are provided in Appendix A for reference. Table 1 can be broken into three distinct sub-groups, the first is Fe-Cr-Al alloys with high-Al additions (designated C36M and C37M), a Fe-Cr-Al alloy with Laves phase dispersions (designated as C35MN), and three Fe-Cr-Al alloys with TiC precipitate dispersions (designated as C35M01TC, C35M03TC, and C35M10TC) which are all variants from the base C35M alloy. The addition of higher-Al contents is suspected to push the phase boundary for Cr-rich α' formation based on the results of Kobayashi and Takasugi [10] thereby reducing it's propensity to precipitate under irradiation. The dispersions of Laves and TiC precipitates are hypothesized to act as permanent hydrogen trapping sites thereby reducing the diffusible hydrogen, which can lead to embrittlement and/or cracking of the alloys during welding.

Table 1: Identified Fe-Cr-Al alloys fabricated for testing to determine weldability and radiation tolerance.

Name	Heat ID	Nominal Compositions (wt. %)							
		Fe	Cr	Al	Mo	Nb	Si	Y	TiC
C35M	C35M3	Bal.	13	5.2	2	-	0.2	0.05	-
C36M	C36M2	Bal.	13	6	2	-	0.2	0.05	-
C37M	C37M	Bal.	13	7	2	-	0.2	0.05	-
C35MN	C35MN6B	Bal.	13	5.2	2	1	0.2	0.05	-
C35M01TC	#20766	Bal.	13	5.2	2	-	0.2	0.05	0.1
C35M03TC	#20767	Bal.	13	5.2	2	-	0.2	0.05	0.3
C35M10TC	#20768	Bal.	13	5.2	2	-	0.2	0.05	1.0

Two primary processing routes to produce these alloys were taken: vacuum induction melting (VIM) or arc melting with drop-casting. VIM production resulted in ~18 kg heats while arc melts were on the laboratory scale with weights on the order of 1 kg. Thermo-mechanical treatments (TMT) were applied to produce optimized microstructures. The specifics of the processing routes for each of the three sub-groups of Fe-Cr-Al alloys can be found in previous reports [9].

3.1.2 Base Microstructure

All alloys slated for irradiation exhibit a fully-ferritic microstructure with varying grain sizes and secondary phase inclusions. The high-Al variants have elongated grains along the rolling direction together with partially recrystallized grains with grain sizes less than 5 µm. The Laves phase and TiC precipitate dispersion alloys are macroscopically similar to that of the high-Al variants but exhibited discrete secondary phase(s) dispersions in the matrix under microstructural examination. The C35MN alloy with Laves phase precipitate dispersions consisted of a sub-grain structure with fine Laves phase precipitate distribution while the C35M01TC, C35M03TC, and C35M10TC alloys had TiC precipitates with size of less than 5 µm uniformly dispersed in the fully recrystallized matrix consisting of ~10 µm-size grains. Representative micrographs of each alloy are provided in Figure 1.

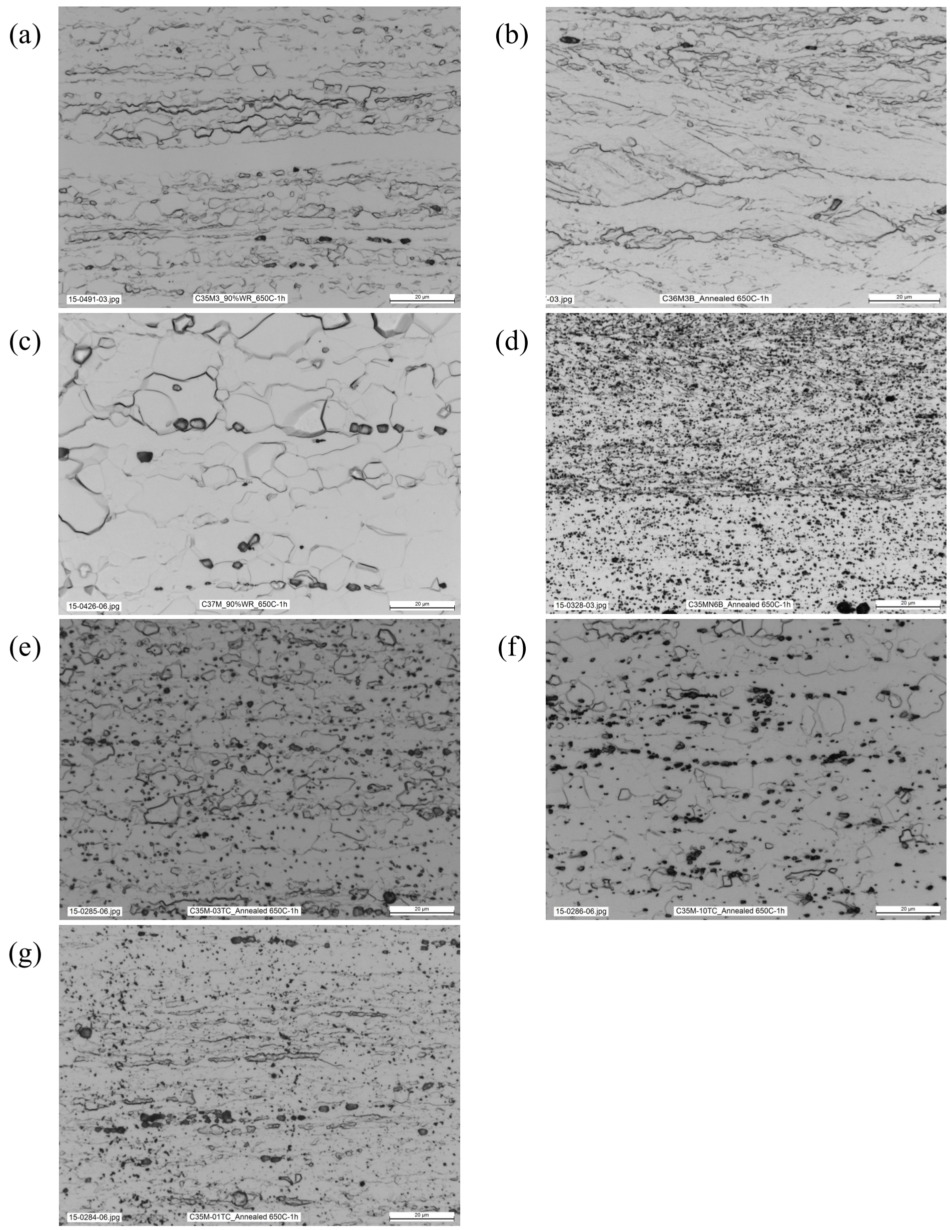

Figure 1: Optical micrographs of candidate Fe-Cr-Al alloys for welding and irradiation testing; (a) C35M, (b) C36M, (c) C37M, (d) C35MN, (e) C35M01TC, (f) C35M03TC, and (g) C35M10TC. Rolling direction is left to right in all images.

3.1.3 Weld techniques and parameters

A sub-section of the as-received material from each alloy was used to conduct autogenous, bead-on-plate welding along the traverse direction. A pulsed laser-welding machine was used to perform the welding. No pre-heating of the specimens was used. Welding parameters were optimized to generate full penetration welds: 7 ms pulse length, 7 pulses/s and 2.12 mm/s welding speed. Lamp energy was maintained to have a nominal average of 100 Watts. These parameters were applied to every sample except the C35MN sample. The C35MN feedstock was thicker than the other alloys resulting in the need for higher laser welding settings. All welding was conducted in an inert argon cover gas. Unlike previous welding trials [9], care was taken to limit the depression in the fusion zone that is a result of low cooling rates. By increasing the cooling rates, the objects remained relatively flat and with limited variation when viewed in cross-section. Figure 2 shows an example of the resulting welds used for specimen fabrication. Figure 2b shows the extraction map for both SS-J2 and SS-2E sample geometries. Staggering of the different specimen types was done to limit overlapping of the heat-affected zone (HAZ) in SS-2E specimens as HAZs extended past the tensile heads of the SS-2E specimens. More details on the specimen geometries are provided in the following section. Similar lay-up configurations to the one shown in Figure 2 were used for all alloys of interest.

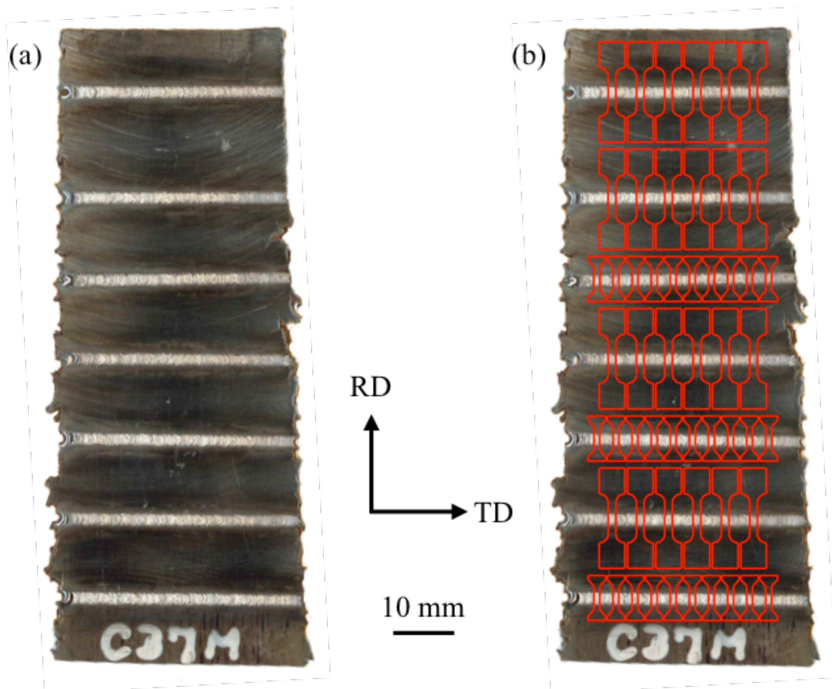

Figure 2: Image of cross-welds performed using laser welding techniques on the C37M alloy; (a) as imaged, (b) with overlays of SS-J2 and SS-2E sample geometries to show where samples were fabricated from in Section 3.1.4.

3.1.4 Specimen geometries and sample manufacturing

For welding and irradiation testing, two tensile specimen geometries will be used to determine mechanical properties. Both configurations, the SS-2E and the SS-J2 configurations, are shown in Figure 3. Appendix B provides the detailed engineering drawings for both specimen configurations. The SS-J2 specimen was selected as the baseline tensile specimen geometry due to the geometry being extensively used for irradiation campaigns within the HFIR. This will allow for comparison to the other nuclear materials such as Fe-Cr and Fe-Cr-Ni based alloys. Furthermore, the sheet type dog-bone configuration allows for efficient stacking within the irradiation capsule geometry and provides effective heat transfer across the stacked faces during irradiation. Here, SS-J2 specimens without pinholes are used. The elimination of the pinhole provides more material for materials characterization sample preparation such as focused ion beam (FIB) preparation and allows for easier loading into the tensile test frame using typical hot cell manipulator configurations. The SS-2E configuration was selected as the ultra-miniature tensile specimen of choice for this campaign [9]. This geometry will significantly reduce the sample activity thereby providing out-of-cell tensile testing when irradiated to low doses (<10-20 dpa). The geometry has been found to accurately mimic the mechanical performance of the SS-J2 configuration when used within the same testing frame and material class [9]. Another key advantage is significantly more specimens can be irradiated at a single time within the same volume occupied by the SS-J2 specimen.

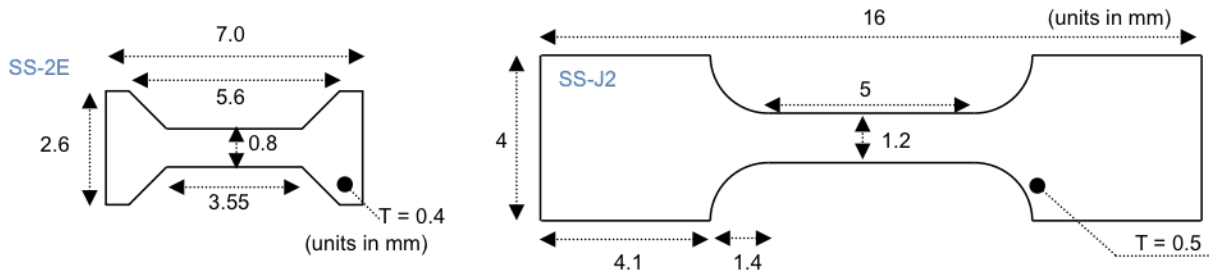

Figure 3: Simplified schematic of the tensile specimen geometries for weld and irradiation testing. Figure not to scale.

A single outside vendor which met the quality requirements of the program manufactured all samples for irradiation. Samples were machined using an electric discharge machine (EDM) from flat sheet product provided to the vendor. Care was taken during machining of the SS-2E specimen geometry as the small features prevented reworking of burned faces from the EDM machine. Hence, a multi-pass technique with gradually lower settings was used to limit the amount (or depth) of the EDM burn layer on each specimen. For larger features, the EDM burn layers were removed to limit any possible fabrication-induced artifacts into the specimens. For welded specimens, care was taken to align the fusion zone of a weld within the center of the gauge region of each tensile specimen. Here, the top-weld was centered on the gauge; some deviation on the bottom-weld from center is anticipated. Due to the thickness of the specimens, it was recognized that both the top and bottom of each specimen needed to be machined to provide specimen thicknesses within the tolerances of the drawings provided in Appendix B. The resulting machining operation would mean losing visual tracking of the fusion zone within the gauge region. To assist with post-fabrication mechanical testing either in the as-received state or irradiated state, each individual sample was imaged prior to surface machining. An example of the C37M batch of welded specimens showing the fusion zone location of each specimen can be found in Figure 4.

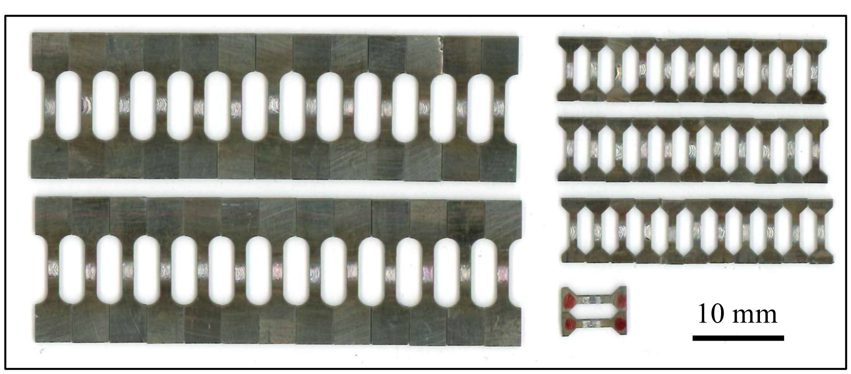

Figure 4: Image of welded C37M specimens prior to surface machining. Red dots denote specimens with fusion zones far from the center of the gauge region of the specimen.

Samples with fusion zones significantly deviating from the gauge center were placed in a separate batch and machined separately. Examples of these specimens are those with red dots in Figure 4. The result is each welded configuration having two smaller batches, those with centered fusion zones and those without. Ideally, all specimens for irradiation will come from the centered fusion zone batch. Batch traceability was maintained throughout the remainder of the fabrication process.

3.1.5 Sample marking and identification scheme

After fabrication all samples were laser engraved according to a predetermined identification scheme. The specimen-marking scheme can be found in Table 2. SS-J2 specimens had a four character marking while due to the small size of the SS-2E specimens the SS-2E specimens were marked in a three-character scheme. The first character in the SS-2E and the first and second character on the SS-J2 specimens provide unique identification of each alloy composition and welded variant. Care was taken to select prefix characters that do not appear to be similar under microscopic investigation to limit ambiguity during post-irradiation sample sorting. In Table 2, "XX" denotes the serial numbering system, i.e. MF01, MF02, etc. Both SS-J2 and SS-2E specimens are marked on each side on alternating ends of the tensile heads. Figure 5 shows the location and example identification markings on both the SS-J2 and SS-2E specimen types. After engraving, samples were dimensioned to determine if the specimens meets the dimensional requirements called out in Appendix B. Those samples meeting dimensional requirements were then deemed ready for irradiation. Those samples that did not meet the stringent requirements were selected for future out-of-pile irradiation testing including either aging or hydrogen loading testing techniques.

Table 2: Specimen ID marking for specimens for weld and irradiation testing

Spec ID.	Specimen Type	Material Code	Condition	Spec ID.	Specimen Type	Material Code	Condition
MFXX	SS-J2	C35M	non-welded	5WXX	SS-J2	C35M	welded
M6XX	SS-J2	C36M	non-welded	VWXX	SS-J2	C37M	welded
MVXX	SS-J2	C37M	non-welded	KWXX	SS-J2	C35MTC01	welded
TKXX	SS-J2	C35MTC01	non-welded	TWXX	SS-J2	C35MTC03	welded
TCXX	SS-J2	C35MTC03	non-welded	HWXX	SS-J2	C35MTC10	welded
THXX	SS-J2	C35MTC10	non-welded	NWXX	SS-J2	C35MN	welded
N5XX	SS-J2	C35MN	non-welded	AXX	SS-2E	C35M	welded
FXX	SS-2E	C35M	non-welded	VXX	SS-2E	C37M	welded
IXX	SS-2E	C36M	non-welded	LXX	SS-2E	C35MTC01	welded
VXX	SS-2E	C37M	non-welded	CXX	SS-2E	C35MTC03	welded
KXX	SS-2E	C35MTC01	non-welded	OXX	SS-2E	C35MTC10	welded
TXX	SS-2E	C35MTC03	non-welded	BXX	SS-2E	C35MN	welded
HXX	SS-2E	C35MTC10	non-welded				
NXX	SS-2E	C35MN	non-welded				

(a) (b)

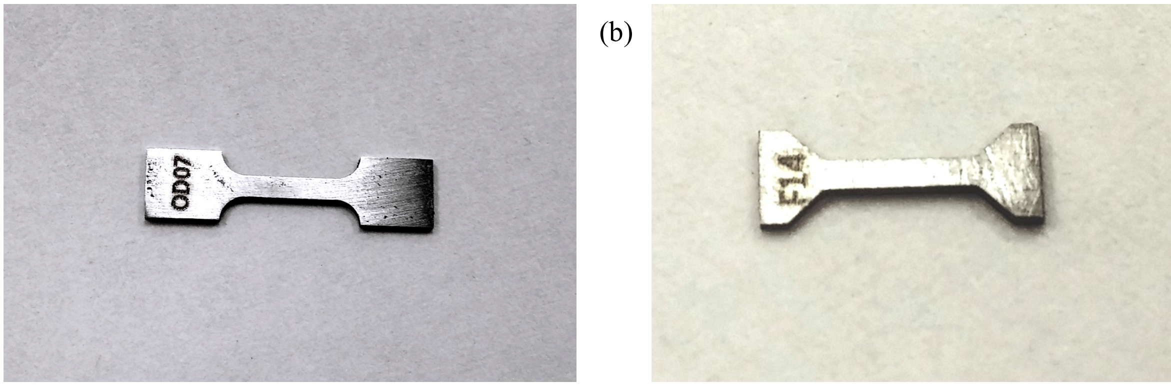

Figure 5: Image of laser engraving positions on sample specimens; (a) position on SS-J2 sample and (b) position on SS-2E sample.

4. IRRADIATION TEST CONDITIONS

4.1.1 Design and configuration of the materials test reactor

The HFIR was selected as the materials test reactor for this study as it operates with the highest flux reactor-based source of neutrons available in the United States. Due to it's high flux, higher doses can be achieved rapidly with an average of ~6-12 dpa per year for ferrous based alloys. The high flux is due to the reactor's design where it is a beryllium-reflected, pressurized, light-water-cooled and moderated flux-trap-type reactor. The core consists of aluminum-clad involute-fuel plates, which currently utilizes highly enriched ^{235}U fuel at a power level of 85 MWt. The core is designed with two concentric annular regions. The inner flux trap provides numerous positions for materials irradiation studies using specialized irradiation capsules otherwise known as "rabbits." Figure 6 shows a schematic of the flux trap positions within the HFIR. In Figure 6, three different types of positions are highlighted: target, peripheral target, and hydraulic tube. Each of these positions have uniquely different neutron flux characteristics leading to small variations in capsule accumulated damage dose. Figure 7 shows the nominal axial neutron flux profile for each of the irradiation positions. Each irradiation position can accommodate several rabbits within a single vertical channel and hence the fast neutron flux received by a rabbit (and therefore the samples) will vary based on selected target type and the vertical alignment within the core. The fast neutron flux will also result in slightly varied irradiation temperatures within the rabbit if all other variables are held constant.

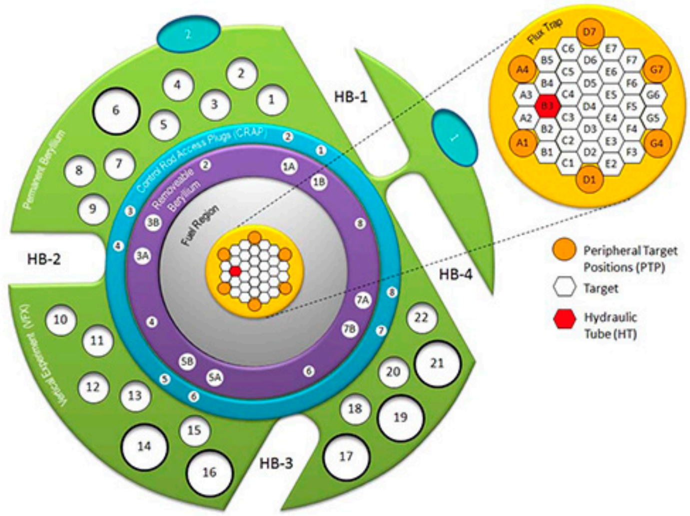

Figure 6: Flux trap irradiation locations in the HFIR.

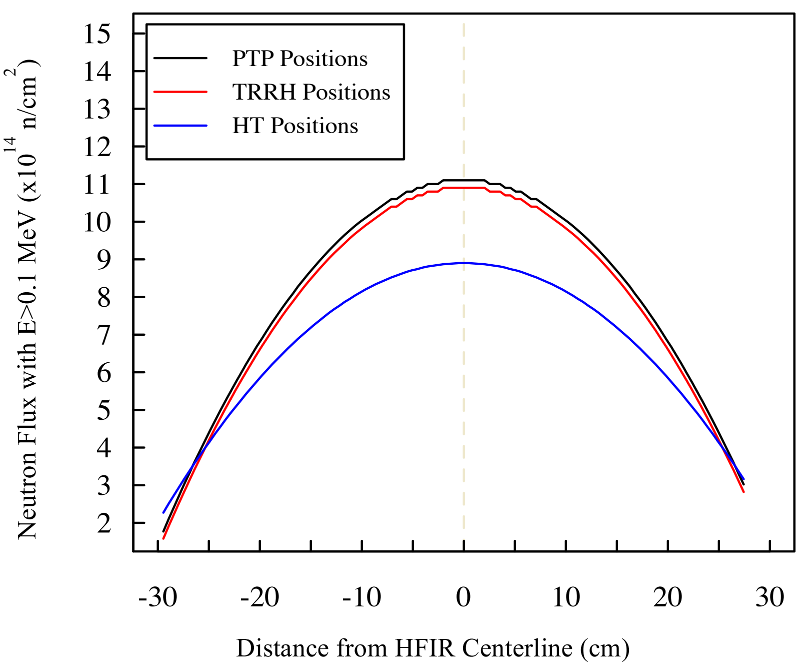

Figure 7: Estimated fast neutron flux at positions within the HFIR. PTP: peripheral target position; TRRH: target rod rabbit holder position; HT: hydraulic tube position.

4.1.2 Anticipated irradiation conditions

Radiation-induced effects, such as dislocation loop formation, as well as radiation-enhanced processes, such as precipitation, are known to be strongly temperature dependent. To probe the temperature dependency of the radiation effects within the candidate Fe-Cr-Al alloys three irradiation temperatures were selected: 200°C, 330°C, and 550°C. Based on previous irradiation studies on Fe-Cr based alloys, these three temperatures will probe three different regimes for the Fe-Cr-Al alloys: a dislocation loop dominated regime at 200°C, a mixed dislocation loop and precipitation dominated regime at 330°C, and softening or limited dislocation loop dominated regime at and above 550°C [11]. The selected temperatures also span a wide range of temperatures seen within current fission reactor designs and possible future designs, hence providing critical data needed for the assessment of candidate welded Fe-Cr-Al alloys for a variety of nuclear power production applications. Along with temperature, the irradiation campaign will also investigate the radiation tolerance of the Fe-Cr-Al alloys as a function of dose. Here, the target doses were selected as 2 dpa, 8 dpa, and 16 dpa. This dose range spans a typical lifetime accumulated dose for a fuel cladding component. Also, doses above 16 dpa will extend past the expected lifetime of the program and have much larger sample activities limiting possibilities for extensive post-irradiation examination efforts. Based on the experimental test matrix, nine unique rabbit configurations are needed. The anticipated insertion date for all rabbits is cycle 462 of the HFIR that is expected to commence on October 6th, 2015. Based on the flux trap configuration for this cycle, 9 positions have been selected for the irradiation campaign all of which are the peripheral target position (PTP) positions. The resulting test matrix based on the positions, insertion date, and irradiation conditions are provided in Table 3.

Table 3: Position of capsules for irradiation within the HFIR. Nominal dose (dpa) is calculated based on a pure-Fe specimen. Dates are approximant.

HFIR Position	Capsule ID	Target Temp (°C)	Number of Cycles	Nominal Capsule Avg. Flux (n/cm^2·s)	Nominal Capsule Avg. Fluence (n/cm^2)	Nominal Capsule Average Dose (dpa)	Capsule Insertion Date	Capsule Release Date
PTP D7 5	FCAT01	200	1	1.10x10^{15}	2.81x10^{21}	1.9	10/6/15	10/30/15
PTP G4 5	FCAT02	200	4	1.10x10^{15}	9.12x10^{21}	7.6	10/6/15	3/18/16
PTP G7 5	FCAT03	200	8	1.10x10^{15}	1.79x10^{22}	15.2	10/6/15	1/10/17
PTP D7 6	FCAT04	330	1	1.08x10^{15}	2.24x10^{21}	1.9	10/6/15	10/30/15
PTP G4 6	FCAT05	330	4	1.08x10^{15}	8.96x10^{21}	7.4	10/6/15	3/18/16
PTP G7 6	FCAT06	330	8	1.08x10^{15}	1.79x10^{22}	14.9	10/6/15	1/10/17
PTP D7 5	FCAT07	550	1	1.10x10^{15}	2.81x10^{21}	1.9	10/6/15	10/30/15
PTP G4 5	FCAT08	550	4	1.10x10^{15}	9.12x10^{21}	7.6	10/6/15	3/18/16
PTP G7 5	FCAT09	550	8	1.10x10^{15}	1.79x10^{22}	15.2	10/6/15	1/10/17

5. DESCRIPTION OF HFIR RABBIT DESIGN

5.1.1 General design concepts

The anticipated flux trap positions provided in Table 3 limit the overall size of the rabbit configuration that can be used for the irradiation campaign. The design used here was based off of a rabbit configuration previously used for HFIR irradiations of 36 SS-J2 tensile specimens. For this program, the design was modified to accommodate both SS-J2 and SS-2E tensile bars. The resulting design is an extremely versatile design where the rabbit can be loaded solely with SS-J2 specimens, SS-2E specimens, or a mixture of the two specimen types. Here, the rabbit configuration was selected to contain 27 SS-J2 tensile bars and 18 SS-2E tensile bars. The rabbit configuration can also handle loading of 12 passive SiC thermometry specimens to validate that the modeled target irradiation temperatures are achieved during the irradiation. The rabbit is configured to house three separate sub-assemblies or modules within the primary outer containment. This modular design has proven to provide ease of disassembly during hot cell operations after irradiation. The result is a design that is both versatile and robust. A three-dimensional rendering of the design is provided in Figure 8 while detailed drawings are provided in Appendix B.

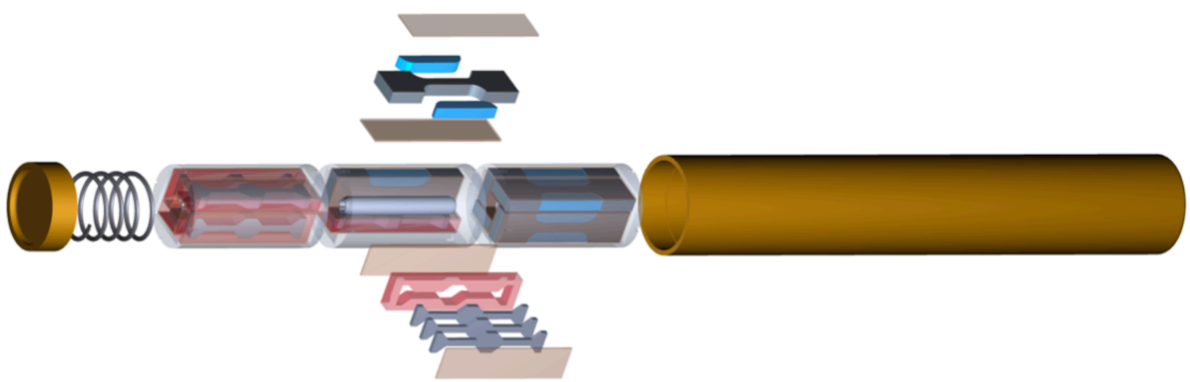

Figure 8: Finalized HFIR rabbit design for irradiation of welded and non-welded tensile specimens.

5.1.2 Determination of SS-2E thermal equivalency

The capsule layout detailed in Figure 8 contains multiple specimen configurations including sets of SS-J2, 0.6 mm thick SS-2E, and 0.4 mm thick SS-2E specimens. This general configuration of specimens was created to analyze and verify thermal equivalency between the different configurations. The motivation was to develop a modular specimen holder geometry that would provide the ability to irradiate various specimen geometries without having to create unique designs for each loading configuration. The concept was based on thermal mass and contact interfaces. Each specimen batch was fitted with complimentary parts (chevrons, liners, sub-holders, etc.) to make the total subassembly resemble identical 'slugs' of material with the same thermal mass and contact resistances. This would allow the unique specimen batches to perform identically, provided a given specimen holder outer diameter to control the capsule gas gap.

ANSYS Finite Element Analysis software was used to perform the thermal analysis for this novel design concept. In order to prove thermal equivalency, the thermal performance of the holder assembly containing only SS-J2 specimens (i.e. the far right sub-assembly in Figure 8) was directly compared to the general loaded holder assembly (middle sub-assembly in Figure 8). The thermal loads for the three configurations, SS-J2, 0.6 mm thick SS-2E, and 0.4 mm thick SS-2E, were 28.8 W, 28 W, and 28 W respectively (i.e. roughly a 2% discrepancy between each specimen set). This difference of heat loads is small relatively to machining tolerances and thermal modeling uncertainties. Moreover, the specimen temperatures ranges for the different configurations are small. Figure 9 shows the specimen performance for different loading configurations. The 550°C design case was used for this demonstration, as the highest temperature case generally produces the most variations in temperature (i.e. worst case). Note that the samples are loaded as a stack, with location 1 being oriented towards the capsule center and location 3 being oriented towards the holder outer wall. Also, the 0.6mm thick SS-2E stack only contains 2 specimens.

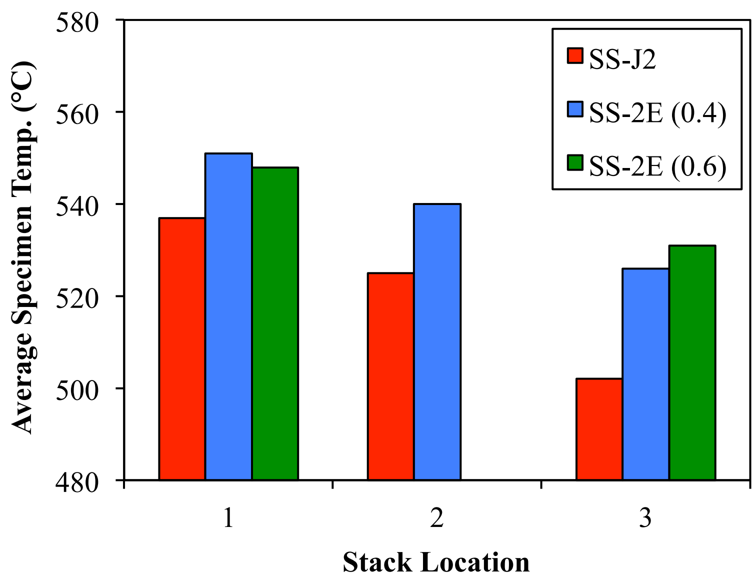

Figure 9. Average Specimen Temperature comparison for the different loading configurations (550°C case).

The SS-2E specimens also have a smaller temperature gradient than its larger SS-J2 counterparts. This provides a more continuous temperature in the gauge length of the specimen which allows for more controlled PIE testing. Figure 10 shows a specimen temperature contour plot comparison between the SS-J2 loaded configuration, and the general loaded configuration that includes SS-J2, 0.6 mm thick SS-2E, and 0.4 mm thick SS-2E specimens. As seen in Figure 10, both SS-2E specimen thicknesses exhibit a reduced temperature gradient when compared to the SS-J2 sets. By tracking the sample loading during assembly and coupling it to the 3D thermal analysis shown in Figure 10, any potential temperature gradients effects can be accounted for during PIE. This will allow for a more accurate analysis of radiation effects in candidate Fe-Cr-Al alloys.

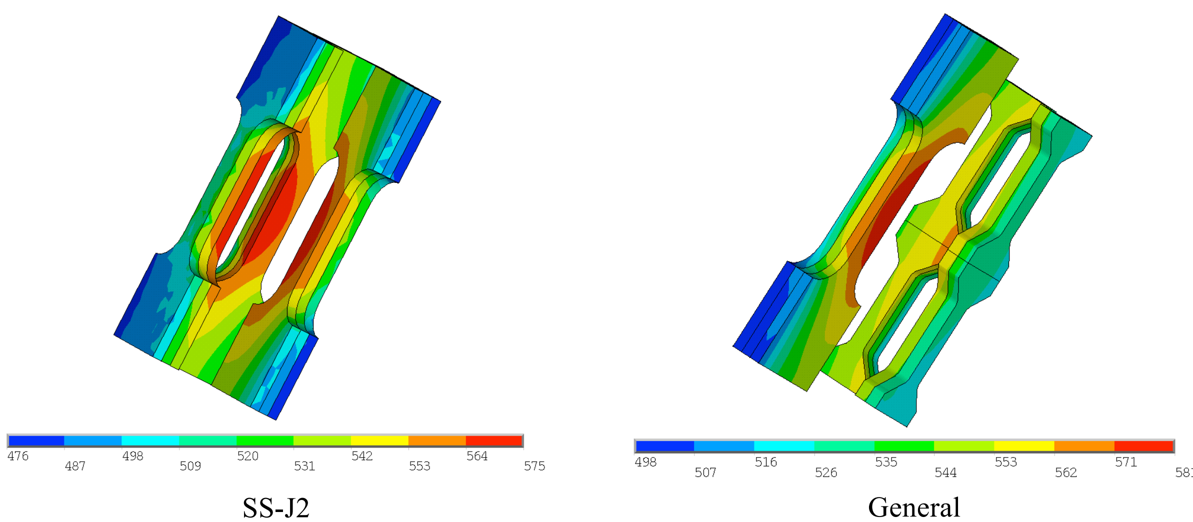

Figure 10. Temperature contour plot comparison between the SS-J2 (only) configuration and the general configuration.

5.1.3 Thermal analysis of irradiation experiment

After determination of thermal equivalency, the specimen temperatures for the loading configuration to be used for the irradiation can be modeled. To control the specimen temperatures during irradiation several variables can be tuned including the axial location within the HFIR, the fill gas, and the radial gap between the specimen holder (transparent geometries in Figure 8) and the outer housing. As seen in Figure 8, the specimens are grouped in stacks of three and are loaded into the four quadrants of the square cutout holder. The selected configuration only uses SS-2E specimens with 0.4 mm thickness. This configuration maximizes specimen loading but does not provide a constant temperature for each specimen in the group. Hence, individual specimen temperatures must be considered resulting in the thermal analysis determining the individual specimens temperatures and denotes them as 'outer', 'middle', and 'inner' specimens. To meet the design temperature specified in Table 3, He was selected as the fill gas. The holder diameters were optimized for the various HFIR positions with ANSYS based on the analysis in Section 5.1.2. The resulting temperatures, associated HFIR positions, and holder diameters can be seen in Table 4.

Table 4: Thermal analysis conditions for a mixed SS-2E and SS-J2 tensile specimens' capsule.

Target Temperature	HFIR Position	Holder Diameter	Specimen Location	Specimen Analysis Conditions		
				Avg.	Min.	Max.
200°C	PTP 5	9.43 mm	Outer	199°C	171°C	242°C
			Middle	222°C	177°C	263°C
			Inner	235°C	181°C	277°C
330°C	PTP 6	9.28 mm	Outer	314°C	288°C	351°C
			Middle	336°C	292°C	373°C
			Inner	348°C	300°C	386°C
550°C	PTP 5	9.00 mm	Outer	502°C	476°C	543°C
			Middle	525°C	484°C	563°C
			Inner	537°C	488°C	575°C

6. SPECIMEN LOADING LISTS AND RABBIT CONFIGURATIONS

As discussed previously, the current configuration allows for 27 SS-J2 tensile bars and 18 SS-2E tensile bars within a single rabbit. Generally, several specimens of each type (SS-J2 or SS-2E) are needed for each specimen type and configuration (alloy and either welded or non-welded, respectively) resulting in a limited number of alloys that can be evaluated in a single rabbit. Due to this limitation, several alloys will not be included in the irradiation including C35M01TC and C35M10TC in either configuration while a C36M alloy in the welded configuration and in the non-welded SS-2E configuration will not be fielded as well. These alloys/configurations were eliminated from the irradiation plan as they were deemed the least significant in meeting the objectives of the irradiation campaign. Several other alloys under investigation from other programs are included in the tests to enable cross comparison of different alloy concepts. The resulting breakdown of alloys and specimens on a per rabbit basis are provided in Table 5. A fully detailed loading list based on compiling Table 3 and Table 5 is presented in Appendix C.

Table 5: Single rabbit loading list by alloy type, specimen type, and configuration. Alloys FCA-ODS and C06M are Fe-Cr-Al alloys currently of interest in other irradiation programs.

Material Code	Condition	Number of SS-J2 per rabbit	Number of SS-2E per rabbit
C35M	non-welded	3	2
C36M	non-welded	3	-
C37M	non-welded	3	2
C06M	non-welded	3	-
FCA-ODS	non-welded	2	-
C35MN	non-welded	2	2
C35M03TC	non-welded	3	2
C35M	welded	2	2
C37M	welded	2	3
C35MN	welded	2	2
C35M03TC	welded	2	3

7. SCHEDULE

At the time of this report all design work has been completed and samples have been fabricated for irradiation. Currently, samples are undergoing final inspection before assembly of the rabbits for irradiation. At the time of assembly, final build sheets including dimensional inspection will be issued for all rabbits deeming the samples capable of insertion into HFIR. All irradiation rabbits are anticipated to be inserted in HFIR cycle 462 with a start date on October 6th, 2015. The first batch of rabbits and the samples contained within will be removed from HFIR on October 30th, 2015. Typically, rabbits are held for 30-60 days before shipment to the Irradiated Materials Examination and Testing (IMET) hot cell facility where rabbits are deconsolidated and individual samples are ready for PIE. The result is the first group of rabbits are expected to be ready for PIE for the first quarter of the 2016 fiscal year. A breakdown of expected dates are provided in Table 6.

Table 6: Anticipated irradiation campaign schedule. Dates are approximant.

Capsule ID	Target Temp (°C)	Number of Cycles	Average Capsule Dose (dpa)	Capsule Insertion Date	Capsule Release Date	Shipment Date to IMET
FCAT01	200	1	1.9	10/6/15	10/30/15	1/4/16
FCAT02	200	4	7.6	10/6/15	3/18/16	5/18/16
FCAT03	200	8	15.2	10/6/15	1/10/17	3/10/17
FCAT04	330	1	1.9	10/6/15	10/30/15	1/4/16
FCAT05	330	4	7.4	10/6/15	3/18/16	5/18/16
FCAT06	330	8	14.9	10/6/15	1/10/17	3/10/17
FCAT07	550	1	1.9	10/6/15	10/30/15	1/4/16
FCAT08	550	4	7.6	10/6/15	3/18/16	5/18/16
FCAT09	550	8	15.2	10/6/15	1/10/17	3/10/17

8. REFERENCES

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[9] K.G. Field, M.N. Gussev, Y. Yamamoto, X. Hu, R.H. Howard, Preliminary Studies on the Fabrication and Characterization of Fe-Cr-Al Alloys Designed to Have Enhanced Weldability and Radiation Tolerance, in, Oak Ridge National Laboratory, Oak Ridge, TN, 2015.

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APPENDIX A: CHEMICAL COMPOSITION REPORTS

DIRATS LABORATORIES

TEST REPORT

Report Number	**R602519**
Report Date	**26-May-2015**
Page	**1 of 2**
Client Order	**ALS15-0626**
Release	**Sample# 3**

RECEIVED	1 Sawn Section approx. 1/4" x 1/2" x 1"
IDENTIFICATION	Sample# 3 ID: C36M3
MATERIAL	Fe-Cr-Al
TEST PER	Client Instructions
RETURN	All Material

PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	6.00	%
B	<0.001	%
Ce	<0.01	%
Co	<0.01	%
Cr	12.98	%
Cu	<0.01	%
Fe	78.80	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	1.98	%
Nb	<0.01	%
Ni	<0.01	%
P	<0.002	%
Si	0.18	%
Ti	0.01	%
V	<0.01	%
W	<0.01	%
Y	0.04	%
Zr	<0.01	%

41 AIRPORT ROAD P.O. BOX 39 WESTFIELD, MA 01086-0039 FAX 413-568-1453 413-568-1571

DIRATS LABORATORIES

TEST REPORT

Report Number	**R594861**
Report Date	**16-Dec-2014**
Page	**12 of 14**

UT-Battelle, LLC
ORNL Fuel Cycle & Isotopes Division
Oak Ridge, TN 37831-6083

SAMPLE Sample# 11 ID: C35M3
PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	5.31	%
B	<3	ppm
Ce	<0.01	%
Co	<0.01	%
Cr	13.06	%
Cu	<0.01	%
Fe	79.43	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	2.00	%
Nb	<0.01	%
Ni	<0.01	%
P	0.007	%
Si	0.13	%
Ti	<0.01	%
V	<0.01	%
W	<0.01	%
Y	0.053	%
Zr	<0.01	%

Quantitative Analysis by Combustion

C	0.001	%
S	<3	ppm

Quantitative Analysis by IGF

O	0.0012	%
N	0.0003	%

Disposition of Chemical Analysis

For Information

The < Symbol signifies not detected at the detectability limit indicated.

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DIRATS LABORATORIES

TEST REPORT

Report Number	**R594861**
Report Date	**16-Dec-2014**
Page	**13 of 14**

UT-Battelle, LLC
ORNL Fuel Cycle & Isotopes Division
Oak Ridge, TN 37831-6083

SAMPLE Sample# 12 ID: C36M2
PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	6.29	%
B	<3	ppm
Ce	<0.01	%
Co	<0.01	%
Cr	13.00	%
Cu	<0.01	%
Fe	78.40	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	1.99	%
Nb	<0.01	%
Ni	<0.01	%
P	0.004	%
Si	0.20	%
Ti	<0.01	%
V	<0.01	%
W	<0.01	%
Y	0.059	%
Zr	<0.01	%

Quantitative Analysis by Combustion

C	0.001	%
S	<3	ppm

Quantitative Analysis by IGF

O	0.0010	%
N	0.0004	%

Disposition of Chemical Analysis

For Information

The < Symbol signifies not detected at the detectability limit indicated.

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DIRATS LABORATORIES

TEST REPORT

Report Number	**R594861**
Report Date	**16-Dec-2014**
Page	**14 of 14**

UT-Battelle, LLC
ORNL Fuel Cycle & Isotopes Division
Oak Ridge, TN 37831-6083

SAMPLE Sample# 13 ID: C37M

PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	7.22	%
B	<3	ppm
Ce	<0.01	%
Co	<0.01	%
Cr	13.01	%
Cu	<0.01	%
Fe	77.49	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	1.99	%
Nb	<0.01	%
Ni	<0.01	%
P	0.004	%
Si	0.19	%
Ti	<0.01	%
V	<0.01	%
W	<0.01	%
Y	0.081	%
Zr	<0.01	%

Quantitative Analysis by Combustion

C	0.001	%
S	<3	ppm

Quantitative Analysis by IGF

O	0.0026	%
N	0.0002	%

Disposition of Chemical Analysis

For Information

The < Symbol signifies not detected at the detectability limit indicated.

This document, including all Disclosures and Limitations, constitutes the entire report of all test services and results. These tests were performed in accordance with Client and Operations Manual requirements.

Signed by Eric E. Dirats, General Manager.

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DIRATS LABORATORIES

TEST REPORT

Report Number	**R602521**
Report Date	**26-May-2015**
Page	**1 of 2**
Client Order	**ALS15-0626**
Release	**Sample #5**

RECEIVED	1 Sawn Section approx. 1/4" x 1/2" x 1"
IDENTIFICATION	Sample# 5 ID: C35M03TC
MATERIAL	Fe-Cr-Al
TEST PER	Client Instructions
RETURN	All Material

PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	5.17	%
B	0.001	%
Ce	<0.01	%
Co	<0.01	%
Cr	13.03	%
Cu	<0.01	%
Fe	79.34	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	1.97	%
Nb	<0.01	%
Ni	<0.01	%
P	0.003	%
Si	0.15	%
Ti	0.22	%
V	<0.01	%
W	<0.01	%
Y	0.04	%
Zr	0.01	%

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DIRATS LABORATORIES

TEST REPORT

Report Number	**R602520**
Report Date	**26-May-2015**
Page	**1 of 2**
Client Order	**ALS15-0626**
Release	**Sample# 4**

RECEIVED	1 Sawn Section approx. 1/4" x 1/2" x 1"
IDENTIFICATION	Sample# 4 ID: C35M01TC
MATERIAL	Fe-Cr-Al
TEST PER	Client Instructions
RETURN	All Material

PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	5.20	%
B	0.001	%
Ce	<0.01	%
Co	<0.01	%
Cr	13.00	%
Cu	<0.01	%
Fe	79.51	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	1.98	%
Nb	<0.01	%
Ni	<0.01	%
P	0.002	%
Si	0.15	%
Ti	0.08	%
V	<0.01	%
W	<0.01	%
Y	0.04	%
Zr	<0.01	%

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DIRATS LABORATORIES

TEST REPORT

Report Number	R602522
Report Date	26-May-2015
Page	1 of 2
Client Order	ALS15-0626
Release	Sample# 6

RECEIVED	1 Sawn Section approx. 1/4" x 1/2" x 1"
IDENTIFICATION	Sample# 6 ID: C35M10TC
MATERIAL	Fe-Cr-Al
TEST PER	Client Instructions
RETURN	All Material

PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	5.14	%
B	0.002	%
Ce	<0.01	%
Co	<0.01	%
Cr	12.95	%
Cu	<0.01	%
Fe	78.82	%
Hf	<0.01	%
La	<0.01	%
Mn	<0.01	%
Mo	1.96	%
Nb	<0.01	%
Ni	<0.01	%
P	<0.002	%
Si	0.20	%
Ti	0.71	%
V	<0.01	%
W	0.01	%
Y	0.01	%
Zr	0.01	%

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DIRATS LABORATORIES

TEST REPORT

Report Number	**R581512**
Report Date	**26-Mar-2014**
Page	**1 of 2**
Client Order	**ALS14-0612**
Release	**ID: 2**

RECEIVED	1 Sawn Section approx. 3/8"thk.x 5/8" x 1 1/8"
IDENTIFICATION	ID: 2 Name: C35MN6-B
MATERIAL	Fe-13Cr
TEST PER	Client Instructions
RETURN	Specimen

PROPERTIES AS SUPPLIED

Quantitative Analysis by ICP-OE

Al	5.11	%
B	10	ppm
Cr	13.00	%
Fe	78.70	%
Mo	1.99	%
Nb	0.96	%
P	<0.002	%
Si	0.18	%
Y	0.044	%

Quantitative Analysis by Combustion

C	0.005	%
S	3	ppm

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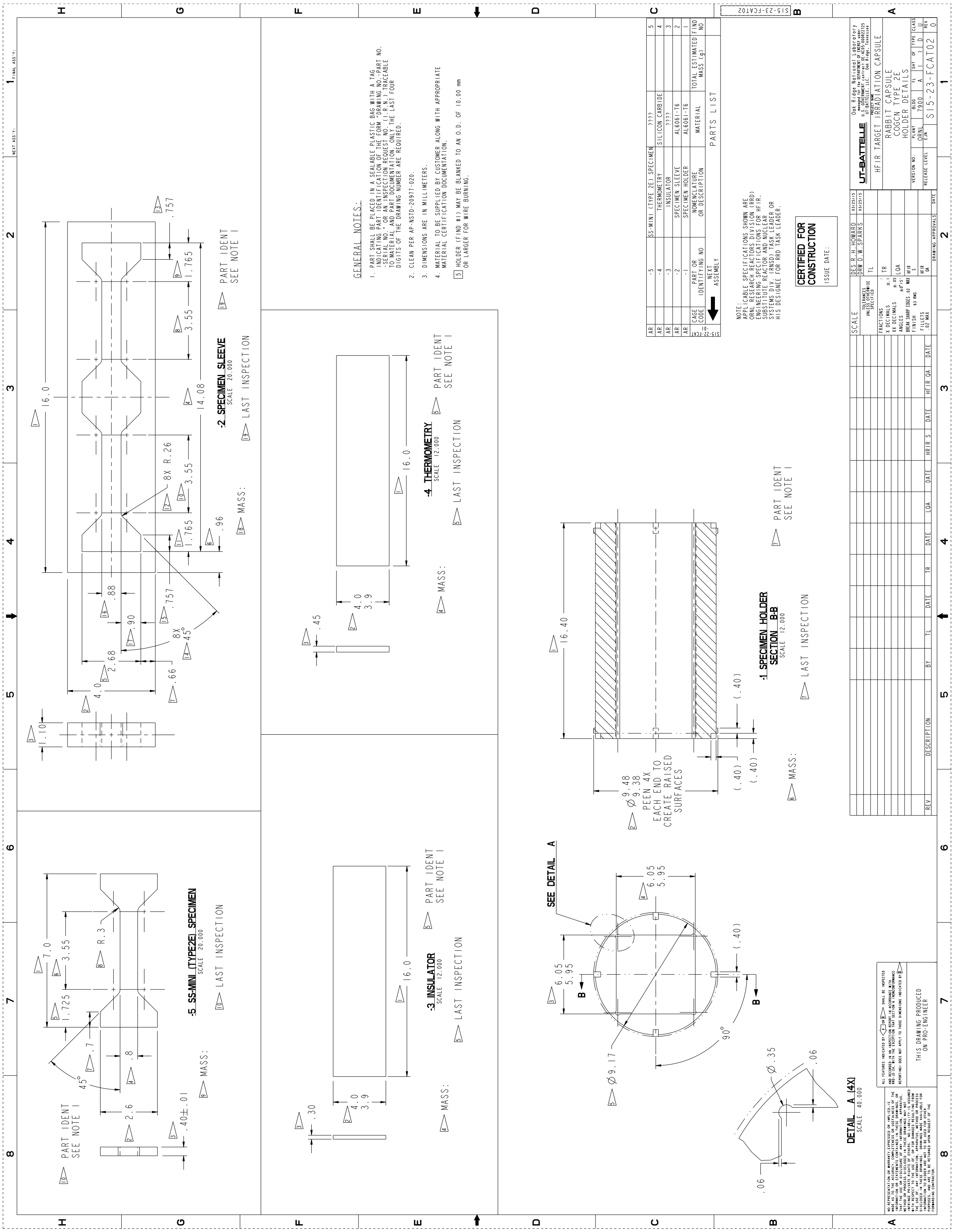
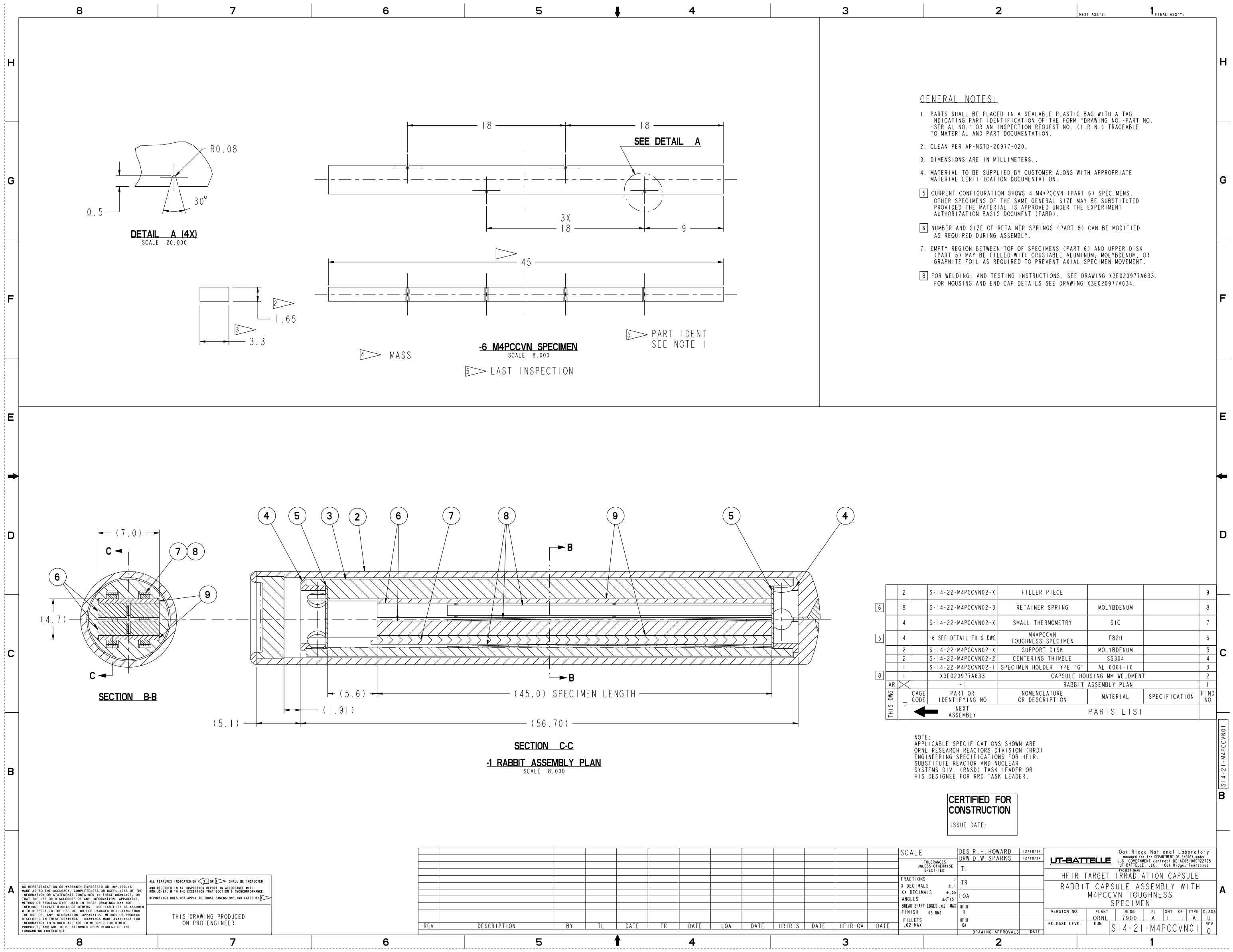
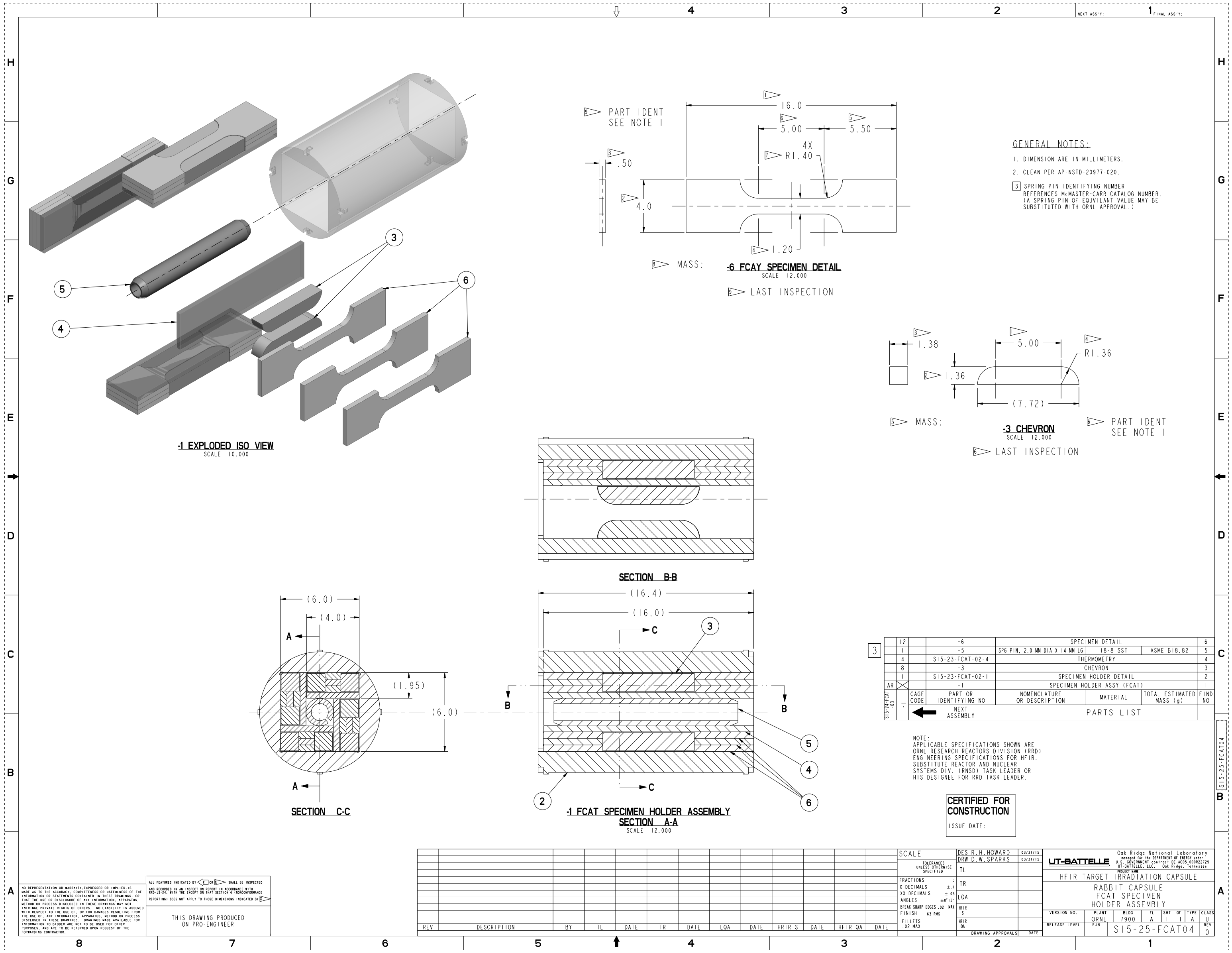
APPENDIX B: CAPSULE ENGINEERING DRAWINGS




GENERAL NOTES:
1. PARTS SHALL BE PLACED IN A SEALABLE PLASTIC BAG WITH A TAG INDICATING PART IDENTIFICATION OF THE FORM "DRAWING NO.-PART NO. -SERIAL NO." OR AN INSPECTION REQUEST NO. (I.R.N.) TRACEABLE TO MATERIAL AND PART DOCUMENTATION.
2. CLEAN PER AP-NSTD-20977-020.
3. DIMENSIONS ARE IN MILLIMETERS..
4. MATERIAL TO BE SUPPLIED BY CUSTOMER ALONG WITH APPROPRIATE MATERIAL CERTIFICATION DOCUMENTATION.
5 CURRENT CONFIGURATION SHOWS 4 M4*PCCVN (PART 6) SPECIMENS. OTHER SPECIMENS OF THE SAME GENERAL SIZE MAY BE SUBSTITUTED PROVIDED THE MATERIAL IS APPROVED UNDER THE EXPERIMENT AUTHORIZATION BASIS DOCUMENT (EABD).
6 NUMBER AND SIZE OF RETAINER SPRINGS (PART 8) CAN BE MODIFIED AS REQUIRED DURING ASSEMBLY.
7. EMPTY REGION BETWEEN TOP OF SPECIMENS (PART 6) AND UPPER DISK (PART 5) MAY BE FILLED WITH CRUSHABLE ALUMINUM, MOLYBDENUM, OR GRAPHITE FOIL AS REQUIRED TO PREVENT AXIAL SPECIMEN MOVEMENT.
8 FOR WELDING, AND TESTING INSTRUCTIONS. SEE DRAWING X3E020977A633. FOR HOUSING AND END CAP DETAILS SEE DRAWING X3E020977A634.
DETAIL A (4X)
SCALE 20.000
R0.08
30°
0.5
SEE DETAIL A
-6 M4PCCVN SPECIMEN
SCALE 8.000
MASS
LAST INSPECTION
PART IDENT
SEE NOTE 1
SECTION B-B
SECTION C-C
-1 RABBIT ASSEMBLY PLAN
SCALE 8.000
(45.0) SPECIMEN LENGTH
(56.70)
2 | S-14-22-M4PCCVN02-X | FILLER PIECE | | | 9
8 | S-14-22-M4PCCVN02-3 | RETAINER SPRING | MOLYBDENUM | | 8
4 | S-14-22-M4PCCVN02-X | SMALL THERMOMETRY | SIC | | 7
4 | -6 SEE DETAIL THIS DWG | M4*PCCVN TOUGHNESS SPECIMEN | F82H | | 6
2 | S-14-22-M4PCCVN02-X | SUPPORT DISK | MOLYBDENUM | | 5
2 | S-14-22-M4PCCVN02-2 | CENTERING THIMBLE | SS304 | | 4
1 | S-14-22-M4PCCVN02-1 | SPECIMEN HOLDER TYPE "G" | AL 6061-T6 | | 3
1 | X3E020977A633 | CAPSULE HOUSING MM WELDMENT | 2
AR | -1 | RABBIT ASSEMBLY PLAN | 1
THIS DWG | CAGE CODE | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION | MATERIAL | SPECIFICATION | FIND NO
NEXT ASSEMBLY
PARTS LIST
NOTE:
APPLICABLE SPECIFICATIONS SHOWN ARE ORNL RESEARCH REACTORS DIVISION (RRD) ENGINEERING SPECIFICATIONS FOR HFIR. SUBSTITUTE REACTOR AND NUCLEAR SYSTEMS DIV. (RNSD) TASK LEADER OR HIS DESIGNEE FOR RRD TASK LEADER.
CERTIFIED FOR CONSTRUCTION
ISSUE DATE:
THIS DRAWING PRODUCED ON PRO-ENGINEER
SCALE
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS
X DECIMALS ±.1
XX DECIMALS ±.05
ANGLES ±0°15'
BREAK SHARP EDGES .02 MAX
FINISH 63 RMS
FILLETS .02 MAX
DES R.H.HOWARD 12/18/14
DRW D.W.SPARKS 12/18/14
TL
TR
LQA
HFIR S
HFIR QA
DRAWING APPROVALS
DATE
UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-000R22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee
PROJECT NAME
HFIR TARGET IRRADIATION CAPSULE
RABBIT CAPSULE ASSEMBLY WITH M4PCCVN TOUGHNESS SPECIMEN
VERSION NO. | PLANT ORNL | BLDG 7900 | FL A | SHT 1 OF 1 | TYPE A | CLASS U
RELEASE LEVEL | EJN | S14-21-M4PCCVN01 | REV 0


-1 EXPLODED ISO VIEW
SCALE 10.000
PART IDENT
SEE NOTE 1
-6 FCAY SPECIMEN DETAIL
SCALE 12.000
MASS:
LAST INSPECTION
GENERAL NOTES:
1. DIMENSION ARE IN MILLIMETERS.
2. CLEAN PER AP-NSTD-20977-020.
3 SPRING PIN IDENTIFYING NUMBER REFERENCES McMASTER-CARR CATALOG NUMBER. (A SPRING PIN OF EQUIVILANT VALUE MAY BE SUBSTITUTED WITH ORNL APPROVAL.)
-3 CHEVRON
SCALE 12.000
SECTION B-B
SECTION C-C
-1 FCAT SPECIMEN HOLDER ASSEMBLY
SECTION A-A
SCALE 12.000
PARTS LIST
SPECIMEN DETAIL
SPG PIN, 2.0 MM DIA X 14 MM LG
18-8 SST
ASME B18.82
S15-23-FCAT-02-4
THERMOMETRY
CHEVRON
S15-23-FCAT-02-1
SPECIMEN HOLDER DETAIL
SPECIMEN HOLDER ASSY (FCAT)
NOTE:
APPLICABLE SPECIFICATIONS SHOWN ARE ORNL RESEARCH REACTORS DIVISION (RRD) ENGINEERING SPECIFICATIONS FOR HFIR. SUBSTITUTE REACTOR AND NUCLEAR SYSTEMS DIV. (RNSD) TASK LEADER OR HIS DESIGNEE FOR RRD TASK LEADER.
CERTIFIED FOR CONSTRUCTION
ISSUE DATE:
THIS DRAWING PRODUCED ON PRO-ENGINEER
DES R.H.HOWARD
DRW D.W.SPARKS
UT-BATTELLE
Oak Ridge National Laboratory
HFIR TARGET IRRADIATION CAPSULE
RABBIT CAPSULE
FCAT SPECIMEN
HOLDER ASSEMBLY
S15-25-FCAT04

APPENDIX C: CAPSULE LOADING LIST

Spec.ID	Specimen Type*	Material Code*	Material or Alloy Composition (Nominal Composition, wt.%)**	Irradiation							
				Target Temp.(°C)	HFIR Position	Avg. Position Flux x10^{15} n/cm^2.s E>0.1 MeV	Cycles	Exposure Time (s)	Estimated Fluence x10^{20} n/cm^2 E>0.1 MeV	Estimated Dose (dpa)	Rabbits ID
BZM01	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A14	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BZM02	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A14	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BM601	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A14	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BM602	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A14	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BZM03	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A44	1.08E+15	8	1.66E+07	1.79E+22	14.9	FCAB02
BZM04	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A44	1.08E+15	8	1.66E+07	1.79E+22	14.9	FCAB02
BM603	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A44	1.08E+15	8	1.66E+07	1.79E+22	14.9	FCAB02
BM604	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A44	1.08E+15	8	1.66E+07	1.79E+22	14.9	FCAB02
BZM05	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP D74	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BZM06	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP D74	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BM605	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP D74	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BM606	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP D74	1.08E+15	4	8.29E+06	8.96E+21	7.4	FCAB01
BZM07	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A46	1.10E+15	8	1.66E+07	1.82E+22	15.2	FCAB02
BZM08	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A46	1.10E+15	8	1.66E+07	1.82E+22	15.2	FCAB02
BM607	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A46	1.10E+15	8	1.66E+07	1.82E+22	15.2	FCAB02
BM608	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A46	1.10E+15	8	1.66E+07	1.82E+22	15.2	FCAB02
BZM09	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A15	1.04E+15	4	8.29E+06	8.63E+21	7.2	FCAB01
BZM10	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP A15	1.04E+15	4	8.29E+06	8.63E+21	7.2	FCAB01
BM609	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A15	1.04E+15	4	8.29E+06	8.63E+21	7.2	FCAB01
BM610	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP A15	1.04E+15	4	8.29E+06	8.63E+21	7.2	FCAB01
BZM11	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP D16	1.04E+15	8	1.66E+07	1.73E+22	14.3	FCAB02
BZM12	M4-PCCVN	C06M	Fe-10Cr-6Al-2Mo	200	PTP D16	1.04E+15	8	1.66E+07	1.73E+22	14.3	FCAB02
BM611	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP D16	1.04E+15	8	1.66E+07	1.73E+22	14.3	FCAB02
BM612	M4-PCCVN	C36M	Fe-13Cr-6Al-2Mo	200	PTP D16	1.04E+15	8	1.66E+07	1.73E+22	14.3	FCAB02
MF01	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
MF02	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
MF03	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
N501	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
N502	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
M601	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
M602	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
M603	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
MV01	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01
MV02	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT01

MV03	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
ZM01	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
ZM02	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
ZM03	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
OD01	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
OD02	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
TC01	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
TC02	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
TC03	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
5W01	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
5W02	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
NW01	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
NW02	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
TW01	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
TW02	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
VW01	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
VW02	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
F01	SS-2E	C35M	Fe-13Cr-5Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
F02	SS-2E	C35M	Fe-13Cr-5Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
N01	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
N02	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
V01	SS-2E	C37M	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
V02	SS-2E	C37M	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
T01	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
T02	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
A01	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
A02	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
B01	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
B02	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
C01	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
C02	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
C03	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
S01	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
S02	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
S03	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP D7 5	1.08E+1 5	1	2.1E+06	2.2E+21	1.9	FCAT01
MF10	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
MF11	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
MF12	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
N507	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
N508	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
M610	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02

M611	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
M612	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
MV10	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
MV11	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
MV12	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
ZM10	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
ZM11	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
ZM12	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
OD07	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
OD08	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
TC10	SS-J2	C35M+TC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
TC11	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
TC12	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
5W07	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
5W08	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
NW07	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
NW08	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
TW07	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
TW08	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
VW07	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
VW08	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
F07	SS-2E	C35M	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
F08	SS-2E	C35M	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
N07	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
N08	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
V07	SS-2E	C37M	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
V08	SS-2E	C37M	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
T07	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
T08	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
A07	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
A08	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
B07	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
B08	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
C10	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
C11	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
C12	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
S10	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
S11	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
S12	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G4 5	1.08E+1 5	4	8.3E+06	9.0E+21	7.4	FCAT02
MF19	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP G7 5	1.08E+1 5	8	1.7E+07	1.8E+22	14.9	FCAT03
MF20	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP G7 5	1.08E+1 5	8	1.7E+07	1.8E+22	14.9	FCAT03

MF21	SS-J2	C35M	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
N513	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
N514	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
M619	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
M620	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
M621	SS-J2	C36M	Fe-13Cr-6Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
MV19	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
MV20	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
MV21	SS-J2	C37M	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
ZM19	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
ZM20	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
ZM21	SS-J2	C06M	Fe-10Cr-6Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
OD13	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
OD14	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
TC19	SS-J2	C35M+TC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
TC20	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
TC21	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
5W13	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
5W14	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
NW13	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
NW14	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
TW13	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
TW14	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
VW13	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
VW14	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
F13	SS-2E	C35M	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
F14	SS-2E	C35M	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
N13	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
N14	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
V13	SS-2E	C37M	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
V14	SS-2E	C37M	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
T13	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
T14	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
A13	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
A14	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
B13	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
B14	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
C19	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
C20	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
C21	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03
S19	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT03

S20	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G7 5	1.08E+1 5	8	1.7E+07	1.8E+22	14.9	FCAT03
S21	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	200	PTP G7 5	1.08E+1 5	8	1.7E+07	1.8E+22	14.9	FCAT03
MV05	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
MV06	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
ZM04	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
ZM05	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
ZM06	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
OD03	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
OD04	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
TC04	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
TC05	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
TC06	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
5W03	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
5W04	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
NW03	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
NW04	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
TW03	SS-J2	C35MTC03- Welded	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
TW04	SS-J2	C35MTC03- Welded	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
VW03	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
VW04	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
F03	SS-2E	C35M	Fe-13Cr-5Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
F04	SS-2E	C35M	Fe-13Cr-5Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
N03	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
N04	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
V03	SS-2E	C37M	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
V04	SS-2E	C37M	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
T03	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
T04	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
A03	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
A04	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
B03	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
B04	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
C04	SS-2E	C35MTC03- Welded	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
C05	SS-2E	C35MTC03- Welded	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
C06	SS-2E	C35MTC03- Welded	Fe-13Cr-5Al-2Mo- 0.3TiC	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
S04	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
S05	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
S06	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP D7 6	9.13E+1 4	1	2.1E+06	1.9E+21	1.6	FCAT04
MF13	SS-J2	C35M	Fe-13Cr-5Al-2Mo	325	PTP G4 6	9.13E+1 4	4	8.3E+06	7.6E+21	6.3	FCAT05
MF14	SS-J2	C35M	Fe-13Cr-5Al-2Mo	325	PTP G4 6	9.13E+1 4	4	8.3E+06	7.6E+21	6.3	FCAT05
MF15	SS-J2	C35M	Fe-13Cr-5Al-2Mo	325	PTP G4 6	9.13E+1 4	4	8.3E+06	7.6E+21	6.3	FCAT05

N509	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
N510	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
M613	SS-J2	C36M	Fe-13Cr-6Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
M614	SS-J2	C36M	Fe-13Cr-6Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
M615	SS-J2	C36M	Fe-13Cr-6Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
MV13	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
MV14	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
MV15	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
ZM13	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
ZM14	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
ZM15	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
OD09	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
OD10	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
TC13	SS-J2	C35M+TC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
TC14	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
TC15	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
5W09	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
5W10	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
NW09	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
NW10	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
TW09	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
TW10	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
VW09	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
VW10	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
F09	SS-2E	C35M	Fe-13Cr-5Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
F10	SS-2E	C35M	Fe-13Cr-5Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
N09	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
N10	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
V09	SS-2E	C37M	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
V10	SS-2E	C37M	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
T09	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
T10	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
A09	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
A10	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
B09	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
B10	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
C13	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
C14	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
C15	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
S13	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
S14	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05

S15	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G46	9.13E+14	4	8.3E+06	7.6E+21	6.3	FCAT05
MF22	SS-J2	C35M	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
MF23	SS-J2	C35M	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
MF24	SS-J2	C35M	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
N515	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
N516	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
M622	SS-J2	C36M	Fe-13Cr-6Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
M623	SS-J2	C36M	Fe-13Cr-6Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
M624	SS-J2	C36M	Fe-13Cr-6Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
MV22	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
MV23	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
MV24	SS-J2	C37M	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
ZM22	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
ZM23	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
ZM24	SS-J2	C06M	Fe-10Cr-6Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
OD15	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
OD16	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
TC22	SS-J2	C35M+TC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
TC23	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
TC24	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
5W15	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
5W16	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
NW15	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
NW16	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
TW15	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
TW16	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
VW15	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
VW16	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
F15	SS-2E	C35M	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
F16	SS-2E	C35M	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
N15	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
N16	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
V15	SS-2E	C37M	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
V16	SS-2E	C37M	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
T15	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
T16	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
A15	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
A16	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
B15	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
B16	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
C22	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06

C23	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
C24	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
S22	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
S23	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
S24	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	325	PTP G76	9.13E+14	8	1.7E+07	1.5E+22	12.6	FCAT06
MF07	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
MF08	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
MF09	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
N505	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
N506	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
M607	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
M608	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
M609	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
MV07	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
MV08	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
MV09	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
ZM07	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
ZM08	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
ZM09	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
OD05	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
OD06	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
TC07	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
TC08	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
TC09	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
5W05	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
5W06	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
NW05	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
NW06	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
TW05	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
TW06	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
VW05	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
VW06	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
F05	SS-2E	C35M	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
F06	SS-2E	C35M	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
N05	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
N06	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
V05	SS-2E	C37M	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
V06	SS-2E	C37M	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
T05	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
T06	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
A05	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04

A06	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
B05	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
B06	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
C07	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
C08	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
C09	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
S07	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
S08	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
S09	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP D75	1.08E+15	1	2.1E+06	2.2E+21	1.9	FCAT04
MF16	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
MF17	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
MF18	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
N511	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
N512	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
M616	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
M617	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
M618	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
MV16	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
MV17	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
MV18	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
ZM16	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
ZM17	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
ZM18	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
OD11	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
OD12	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
TC16	SS-J2	C35M+TC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
TC17	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
TC18	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
5W11	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
5W12	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
NW11	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
NW12	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
TW11	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
TW12	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
VW11	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
VW12	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
F11	SS-2E	C35M	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
F12	SS-2E	C35M	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
N11	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
N12	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
V11	SS-2E	C37M	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05

V12	SS-2E	C37M	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
T11	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
T12	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
A11	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
A12	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
B11	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
B12	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
C16	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
C17	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
C18	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
S16	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
S17	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
S18	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G45	1.08E+15	4	8.3E+06	9.0E+21	7.4	FCAT05
MF25	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
MF26	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
MF27	SS-J2	C35M	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
N517	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
N518	SS-J2	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
M625	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
M626	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
M627	SS-J2	C36M	Fe-13Cr-6Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
MV25	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
MV26	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
MV27	SS-J2	C37M	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
ZM25	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
ZM26	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
ZM27	SS-J2	C06M	Fe-10Cr-6Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
OD17	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
OD18	SS-J2	125YF-ODS	Fe-12Cr-5Al-O-Y	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
TC25	SS-J2	C35M+TC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
TC26	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
TC27	SS-J2	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
5W17	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
5W18	SS-J2	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
NW17	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
NW18	SS-J2	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
TW17	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
TW18	SS-J2	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
VW17	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
VW18	SS-J2	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
F17	SS-2E	C35M	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06

F18	SS-2E	C35M	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
N17	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
N18	SS-2E	C35MN	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
V17	SS-2E	C37M	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
V18	SS-2E	C37M	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
T17	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
T18	SS-2E	C35MTC03	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
A17	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
A18	SS-2E	C35M-Welded	Fe-13Cr-5Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
B17	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
B18	SS-2E	C35MN-Welded	Fe-13Cr-5Al-2Mo-1Nb	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
C25	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
C26	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
C27	SS-2E	C35MTC03-Welded	Fe-13Cr-5Al-2Mo-0.3TiC	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
S25	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
S26	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06
S27	SS-2E	C37M-Welded	Fe-13Cr-7Al-2Mo	550	PTP G75	1.08E+15	8	1.7E+07	1.8E+22	14.9	FCAT06